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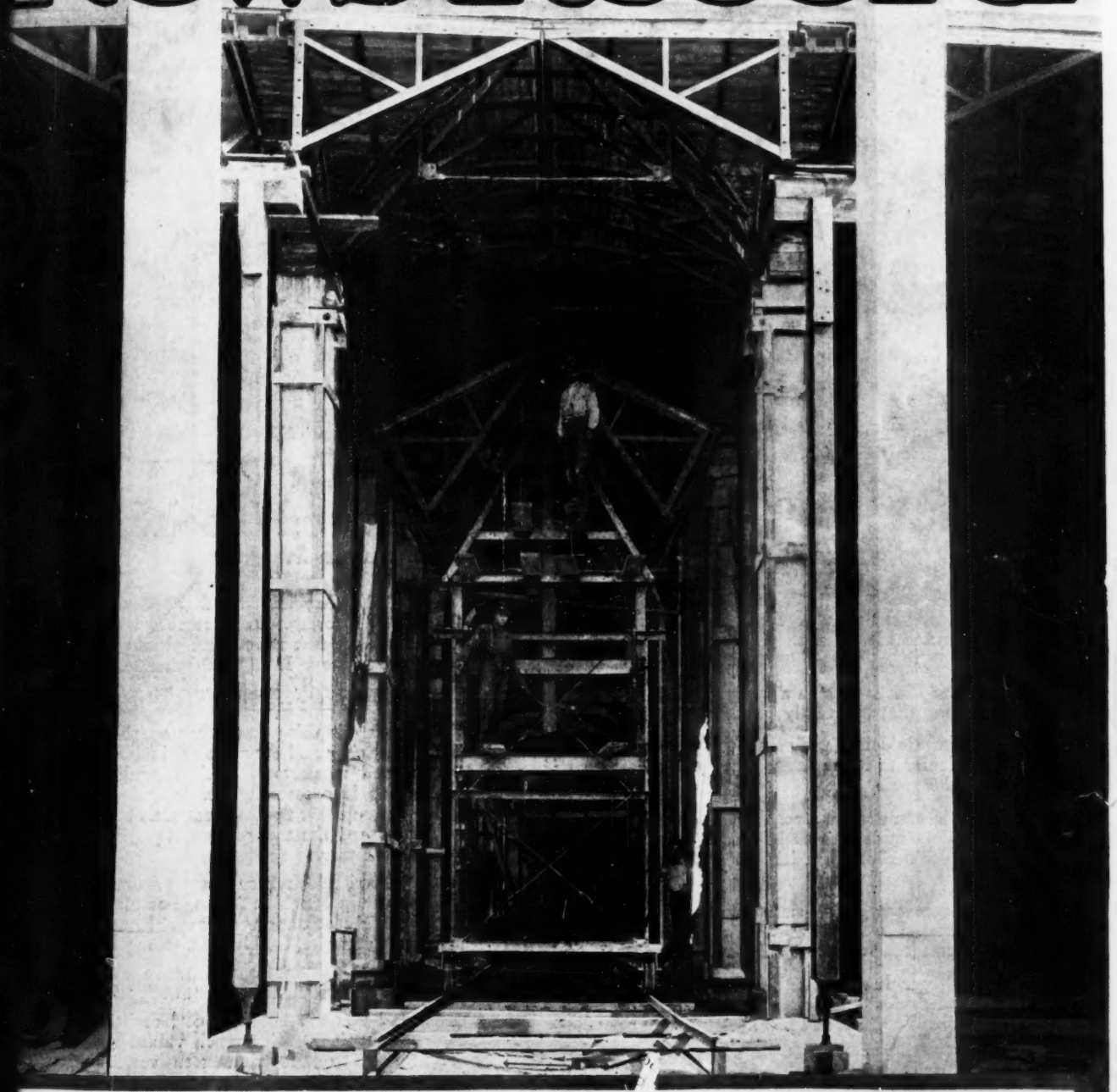


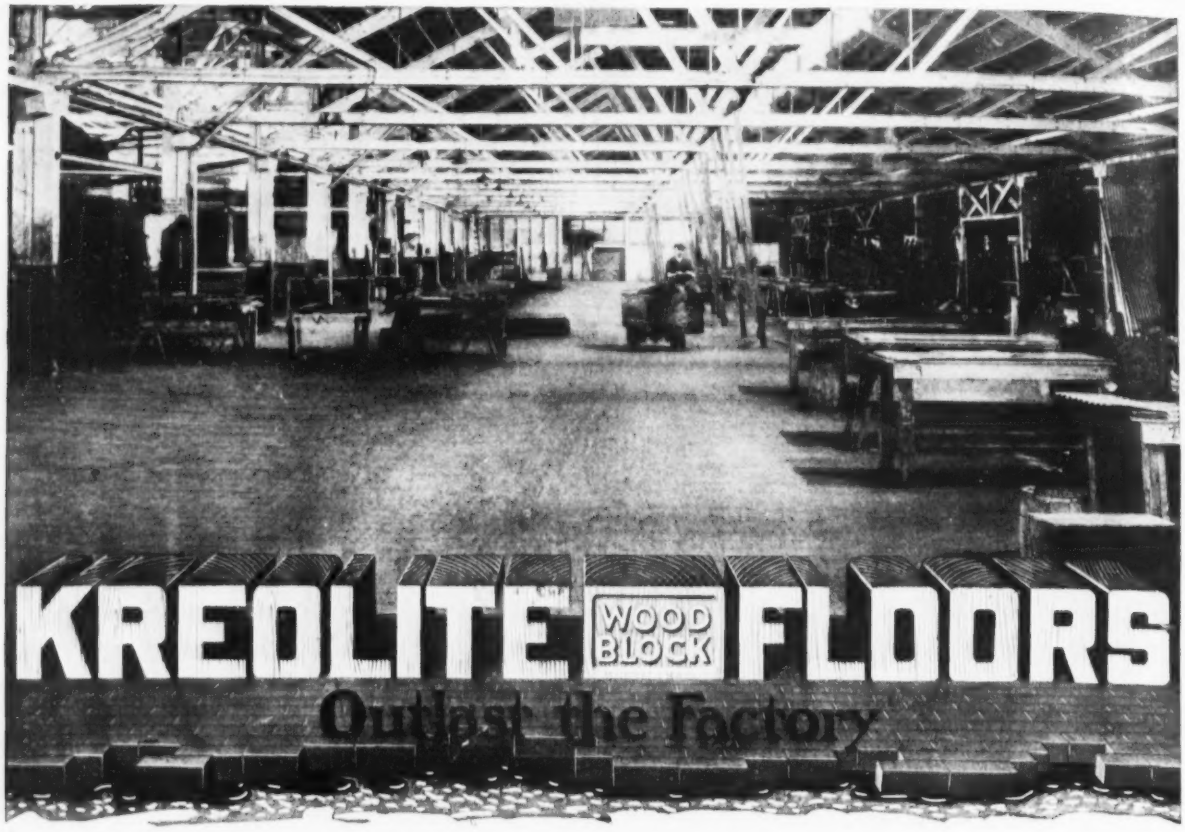
Analyze Chicago Track-Elevation Costs

High-Service Irrigation Pumps and Conduit

By B. P. Fleming

Erection Cranes in Great Lakes Shipyards

Moving Roof Forms by Large Traveler in Concrete Reservoir at St. Paul



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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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What Do You Want From Your Legislature?

THIRTY-THREE state legislatures meet this year. What do you, reader, want from yours in behalf of your city or state, the engineering profession, the returning soldier, or to better the relations between employees and employers, or to help solve the increasingly serious utility problems of the day? The question would be most appropriate for discussion before local and state engineering societies. Many of the latter will meet this month and next. Meanwhile, each engineer and contractor may well ask himself and his fellow, "What do you want from your legislature?"

Low Labor Costs With High Wages

OF THE two chief construction-cost factors, materials and labor, one is inflexible, the other flexible. Material prices are what they are, and there is no recourse. Wages are relative to what the laborer produces. Steel-erection costs in the vicinity of New York are very much lower today than they were ten years ago, *though wages have doubled.* The reason is simple: *The men are producing more per dollar of wage.* Labor leaders are recognizing that to maintain high wage levels production must come up in proper proportion. We know of one construction job on which labor leaders are working with the owner (in this case the Government) to bring up the admittedly large output per man. In consequence, costs have been reduced 30 per cent. as against what they were some months ago. With such a wage policy adopted generally by the labor unions, the labor costs, even with present wage scales, need not be above pre-war costs. Only high material prices would then remain to becloud the construction horizon.

Rural Development Urged by Governor of New York

IN HIS message to the legislature Governor Smith of New York has urged very strongly the coöperation of his state with the national Government in creating land settlements for soldiers. In doing so he heartily indorses the plans laid out by the Secretary of the Interior for coöperation between the Federal Government and the individual states. He well says: "It is becoming more and more apparent that the ability and the experience of our agricultural leaders should be mobilized to create a planned rural development which will include cooperative organization for buying and selling, a system of credit that will give broader opportunities for men of small capital to become farm owners, and a better social life." We have generally associated with Western conditions such rural projects as that so well described by the Governor, but every one familiar with rural conditions in the West realizes the need for well planned rural projects, even in the most thickly settled districts. Such projects would take advantage of all of the experience and experimentation which has resulted from Federal initiative or from successful local communities in every part of the country. The remarkable development at Durham, Cal., of the State Land Settlement Board is a pattern that can easily be duplicated if existing agencies are called upon for help. The entry of New York State into such a land settlement scheme would give an impetus for better agriculture throughout the entire East, and we sincerely trust, therefore, that the New York legislature will give attention to this feature of the Governor's message. While put forth principally as a reconstruction measure, it has promise of great influence as a peace-time measure.

War Control of Highways Here and in Great Britain

A COMPARISON of highway construction control in the United States and Great Britain during the war will be found elsewhere in this issue. It is written by an engineer who had close contact with the control work in this country and constant access to reports of the English Road Board's activities. His attitude toward the work of the United States Highways Council is quite favorable, while that of *Engineering News-Record* during the activities of the council was decidedly critical. There is all the more reason, therefore, why a hearing should be given to what may be interpreted as approximating the council's own view. Two points should be advanced in extenuation of the heavily restrictive activity of the council: First, that the narrowness of policy, the failure to recognize the war-function of highways, was due very largely to the attitude of one member of the council; and, second, that during the last month of the council's life there was marked progress in the direction of a more liberal policy. One man, it will be contended, should not have been able to hamstring the whole council; yet that was possible when the man in question held the whip hand—in his control over materials. In the matter of more liberal policy, the increase in the number of projects approved in the month before the signing of the armistice indicates that if the war had continued there is likelihood that the council's stand would have changed to full recognition of the highway's place in the war scheme. As it was, however, criticism lay heavily on the council for its too heavily restrictive attitude.

Will New York Engineers Fail in Their Civic Duty?

AS THIS issue goes to press there is grave danger of the engineers of New York City failing in their civic duty. Elsewhere in these columns are the details of the sudden discharge of 300 engineers of the Public Service Commission, resulting in the disruption of an excellent engineering organization and in a probable heavy loss, through delayed work, to the city. The situation calls for immediate and organized protest by engineers. The work being chiefly of a civil engineering nature and of a public character, responsibility for calling a meeting lies either with the organized body of civil engineers or with an organization designed to handle public questions of an engineering nature. There being no local society of civil engineers in New York, responsibility lies between the American Society of Civil Engineers and the Engineering Council. The society, holding that it had passed its civic functions to the Engineering Council, promptly, by telephone message of its secretary, urged the council to take the matter in hand. Up to this writing (Tuesday, noon), the executive committee of the council has refused to call the much-needed meeting of protest.

The reason has not been made public, but the weakness of the committee's position is shown by the known fact that it is ready to take action if it receives a *formal communication* from the Public Service Commission or from one of the Founder societies requesting action. *Formal communication!* when the story of the injustice and the disruption is spread in every newspaper in New York City, when an Associate of the American Society of Civil Engineers has spread the matter before the council in a letter, when the secretary of the same society has urged the council by word of mouth to act, when other engineers who know the situation thoroughly have orally put the matter before the council's executive committee. *Formal communication!* while meanwhile every engineer in New York City with red blood in his veins is boiling at the injustice to his fellows and the loss to the city. But the end is not yet. Before the week is out, we hope, the executive committee of the council will have acted, and the engineers of New York will have registered a ringing protest. Meanwhile, this weakness of engineering society organization in New York City needs to be recorded, this inability of the engineers to secure quick action in the discharge of their civic responsibilities. The Engineering Council will have its side to tell, but this fact is outstanding, that it has delayed action awaiting a *formal communication* on a pressing matter on which even the man in the street is informed.

Theodore Roosevelt and the Engineer

THIS is not the place for any extended comment on the personality or work of Theodore Roosevelt. For two of his activities, though, engineers have especial reason for remembering and honoring him—his vigorous backing of the Panama Canal work and the impetus he gave to the movement to conserve our natural resources. In both he displayed a keen appreciation of technical features and backed the engineers with a vigor that could be the result only of strong faith in men of professional training.

His interest in the Panama work, particularly, was of value to the nation. The project had dragged along in the report stage for years. With his accustomed desire for action, he put the job under way, first taking what was then the very sensational step of casting aside the majority report of the international commission, which favored a sea-level canal, and accepting the minority's view. We know now, as a result of the building of the canal, that he was well advised in his choice. What part he played, whether of action or acquiescence, in the Panaman revolution, the first step in the realization of the canal project, is not for discussion here.

In the conservation movement his ability to grasp problems was no less clearly shown, and with the emphasis that he so well knew how to put on things that he wanted cast into the public eye, he made conservation the most talked-of subject in the country in a few weeks' time. What the result of his work in this direction has been has not, so far as we know, been appraised. That it gave a new impetus to the engineers' work in trying to conserve our resources there is no doubt. The full vigor of the early propaganda seemingly is lost, but there is good reason to believe that much of it has been translated into effective machinery for investigation, administration and operation.

In respect to one of his activities the engineers of the future will have more cause than those of the present to remember Colonel Roosevelt. The social-justice program of his 1912 campaign was about six years ahead of the time. Belittled then and scoffed at, it has now been accepted by employers, in theory at least. There was clear evidence of that at the recent Atlantic City Reconstruction Conference. In the coming day those instrumentalities of industrial coöperation will be placed on a scientific, on an engineering, basis, and then some engineers will revert to the 1912 campaign and marvel at the foresight of Colonel Roosevelt and at the denseness of American business.

Administrative Ability in Technical Work

IN THE readjustment for peace conditions which is now just beginning, one of the serious mistakes made in the readjustment for war conditions, which was carried out in 1917, should be avoided. When the nation's resources were being mobilized, eighteen months ago, there was a great demand for engineers to fill places in the little rectangular spaces of numberless so-called organization charts. The harassed higher officials, with their utterly inadequate staffs, trained in precedents and fettered by red tape, had to create proper organizations while carrying on business with what they had. The Construction Division of the Army grew out of an unimportant section of the Quartermaster Corps into a most effective agency because it had the benefit from the outset of the advice of some of the most successful engineers and builders in the country. In the same way the Bureau of Mines, with the help of successful specialists, organized the Chemical Warfare Section, the most imposing aggregation of chemical technologists the country has seen. But there are other departments whose success has been less marked, which

brought into their organizations a large number of technical men of good reputation, but which nevertheless failed to make much progress. These conditions have caused much comment, and the general explanation of them, made by men who have been successful in private life and successful in Government work during the war, is full of warning to those who are taking up the readjustment to meet the requirements of peace.

Where a war-time agency has been successful, it has had an organization in which the difference between technical knowledge and administrative ability has been recognized in the appointments and the scheme of management. In a general way, everybody recognizes this difference, but practically few men, not themselves experienced executives, appreciate its importance. Bureau chiefs in Washington, whose salary lists were so low they could not obtain men of both technical and administrative ability in competition with private corporations, failed to realize that such men would be willing to serve the public in war times at Government rates of compensation. The new men they brought together often lacked administrative capacity, and needed so much overhead direction and control that progress was slow, in spite of the abundance of technical talent that was gathered together.

This is not the place to enter into a prolonged discussion of the administration of technical undertakings. It is enough to say that the war has proved beyond question that, while there is an abundance of technical talent in the country, the combination of technical and administrative talent necessary to make speed economically in war times is the same combination necessary to make profits in peace times, and it is far from plenty. It is the result of an astigmatic view of the duties of the average technical executive, which lays stress on his scientific knowledge and blurs the importance of his ability to plan and direct the work of others. Administrative capacity has a higher value than technical knowledge in many presumably technical positions, and as it is more difficult to obtain it should be examined into more carefully. The technical schools should also recognize this fact, and turn out graduates who know that the ability to direct others successfully has a big cash value, even in a scientist.

Political Piracy With the Engineer as Victim

POLITICAL piracy has many discreditable deeds in its book, but most of these are outdone by the action of New York City's governing body, the Board of Estimate and Apportionment, in tearing to pieces the Public Service Commission's engineering department on the eve of the new year. Certain consequences of this action, perfectly obvious and as well known to the board as to any citizen, have an ugly appearance. But because a great enterprise of engineering construction is involved, and a great engineering organization performing urgently necessary functions is made the immediate victim of the vicious act, the occurrence becomes one of peculiar concern to engineers.

By vote of the board in connection with a running-expense appropriation, the commission was ordered to dismiss a third of its staff. More than 300 engineers were thrown out on a few hours' notice, without apology or farewell. These men were and are badly needed, on rush work now under construction and on other work soon to be let. So far the bare facts—except perhaps the brief note that, as every one in the street knows, the board has for some time been engaged in bitter personalities with the commission as a whole and with individual members.

Now for the background, of justification or accusation. A score of subway and elevated railway contracts are under way. Some of them were being urged along as fast as possible, as closing links in lines shortly to be put in operation. Many other contracts for finishing work and equipment are also under way. Additional work was being prepared for contract, and this, besides its local importance in helping to bring the city's sadly deficient transit facilities up to requirements, would have been of national influence in aiding to restore the normal course of industrial life in the nation, momentarily checked and reluctant.

All of this activity under the Public Service Commission's jurisdiction is vitally dependent for its progress on the engineering department. A highly expert organization—now wantonly dismembered—had been built up in the course of years to perform this essential municipal service.

By contract stipulation, all engineering data, all lines and grades, all directions and instructions as to quality and quantity, all estimates for payment, must be supplied by the engineers. In much of the work the constant day-and-night attendance of engineering parties is required, aside from inspection. Without this engineering service, the contractors cannot proceed; their work will be delayed, their plant and organization expense continuing, and the city, in the end, must pay the bill. Delay in subway service means further cost—a week's interest on the idle investment already made will weigh up the three-month "saving" in salaries which the board accomplished.

It was known to the Board of Estimate, which itself passed upon the contracts, that the construction work cannot go along without the engineers. It was known to the board that New York needs the service of the new lines, and is paying tens of thousands of dollars daily in interest on idle investment. It was the board's plain duty to know that losses of great amount would fall upon the city if it delayed the work. Did the board, then, act in ignorance? Or must we entertain the hypothesis that it acted with deliberate malice?

So far as engineers are citizens merely, their interest lies in fighting the wrong done the community, and in coöperating with the rest of the community in answering the challenge of the recreant officials by the law and by the ballot. As technical men, however, they have a somewhat specialized duty.

It is their privilege as well as their duty to brand with proper opprobrium the baseness that uses a great engineering work as the plaything of personal antagonisms. It is theirs to write on the record a proper characterization of the outlawry that destroys a trained engineering organization, a municipal asset. And, we think, it will be their privilege to take this occasion for protesting against the subordination of intricate technical problems, and of men trained in their solution, to the whims of political chancemen.

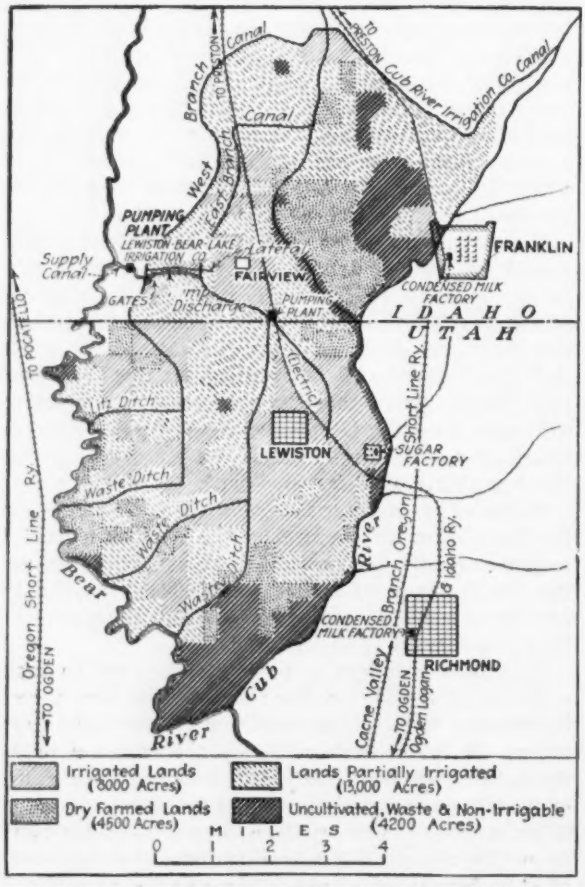
Electrically Driven High-Lift Centrifugal Pumps Supply Water for Irrigation

Water Forced Through Steel Manifold to Reinforced Concrete Conduit Leading Up to Canal—Design Features—Pump Tests Show Over 81 Per Cent. Efficiency Under 90-Foot Head—Construction Work

By B. P. Fleming
Mechanical Engineer, Member American Society of Civil Engineers, Iowa City, Iowa

EVERY year sees greater strides made in irrigation by pumping. This article describes a new high-lift irrigation pumping project with steel manifold and reinforced-concreted force main, put in successful operation in 1917 for supplementing the water-supply of a large area known as the "Lewiston Flat" in northern Utah and southern Idaho. This district is one of the most progressive and productive agricultural districts of the inter-mountain region, the products being sugar beets, dairy products, alfalfa, grains and potatoes. Two sugar-beet factories and two condensed-milk factories are located in the district, and the farming generally is on an intensive and profitable basis where and when water for irrigation is obtainable. Power at low cost as well as intensive agriculture make high-lift pumping feasible.

The irrigable area of the district has been estimated at about 30,000 acres, of which about 20,000 are under existing canals. For the past 40 years the water-supply has been derived from a small stream known as the Cub River, a tributary of the Bear River. The flow of the Cub varies from about 400 sec.-ft. in June to an amount not exceeding 60 sec.-ft. in July and August, during which months the valuable sugar-beet crop is most in need of water. In normal years about 8000 acres of the Lewiston district would be fairly well supplied with water over the entire season, 8000 acres would receive only sufficient to grow grain crops or mature one crop of hay, while 4000 acres might receive no water at all.



CLASSIFIED DISTRIBUTION OF LANDS IN LEWISTON FLAT IRRIGATION PROJECT, IDAHO, UTAH

The securing of such a supply of water as might permit not only of adequate irrigation of the area now farmed but also would lead to a development of the entire irrigable area, has been a very important public question in the district for many years. Various surveys both by Government and private agencies have shown the economic impractability of development of additional water-supply either by gravity flow from the Bear River or by storage developments on the Cub River, so that pumping from the Bear River seemed to be the only solution of the problem.

The Bear River lies from 85 to 90 ft. below the general level of the lands in question. Its natural flow has been entirely appropriated by agricultural and other interests along its course in Idaho and Utah, so that the only hope of the district was in securing a right to stored water. This, fortunately, was obtainable through the extensive storage developments begun by the Telluride Power Co. and completed by its successor, the Utah Power & Light Co., on the body of water known as Bear Lake, in northern Utah. This development comprised the construction of a large pumping plant of 1500 sec.-ft. capacity and control gates which, together with an artificial channel between Bear Lake and the Bear River, make it possible to divert floods into the lake and store them there, or, in case of long-continued drought, permits the pumping out of the waters of the lake to a depth of 17 ft. below the normal stage, and thereby augmenting the flow of the river.

The object of this development is to insure continuity of operation of the large hydraulic power plants established on Bear River, but, incidentally, it has assisted to a certain extent in the possibility of agricultural development, by providing some stored water for the use of those who are able to secure a right to it, and who can divert it below the power plants. The attractive rates for electrical power for pumping offered by the power company, together with the offer of a right to a certain amount of stored water, led to the inception of the project here described. The amount of water estimated as necessary to be supplied by pumping, to supplement gravity water, was 10,000 acre-ft. Since

this amount must be supplied mainly within a period of 50 days, the capacity of the plant became fixed at 100 sec.-ft. For flexibility in operation, it was decided arbitrarily to build a plant of four units of 25 sec.-ft. capacity each.

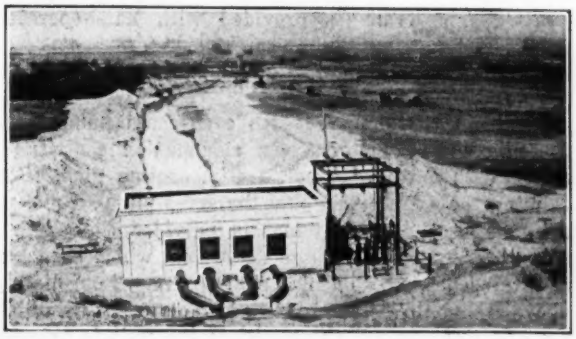
The plant was located directly west of Fairview, Idaho, at which point the Bear River approaches quite near to the present canal system of the Cub River Irrigation Co., into which the pumped water was to be discharged.

The site finally selected for the plant was on a hillside and flat adjacent to a V-shaped bend in the Bear River. Preliminary studies were made of the comparative cost and general suitability of a plant located at the river and discharging into a canal at the crest of the hill through a long wood-stave force main, and a plant located at the base of the hill and taking water from a supply canal leading to the river and discharging through a comparatively short concrete or steel pipe into the canal. Test pits dug on the line of the pump supply canal and at the proposed site of the pump-house structure seemed to indicate that although water would be encountered in large quantities, the necessary excavation required by the second plan could be carried on without serious difficulty. How far this surmise missed the true conditions is related under "Construction." The comparative studies made indicated that the second plan was the more feasible and economical, particularly since it was the desire to eliminate entirely the use of wood-stave pipe, which under the conditions of a pumping plant in use only a few months of the year, cannot be properly maintained. The distance through which the water would have to be carried under pressure, in the case of a plant located at the river, and the size required, seemed to indicate that only a wood-stave pipe could be considered from the standpoint of initial cost—and this fact was of the greatest weight in the decision to adopt the other type of plant.

Another factor having an important bearing upon the general design of the pumping station was the type of pump to be selected, whether vertical or horizontal. This matter was not decided until after bids had been received upon both types. It is significant of the favor with which these two types of units are regarded by the pump manufacturers themselves that, out of seven manufacturers represented, only one would offer a bid upon the vertical unit, and the others were most decidedly opposed to its use under the circumstances.

After various studies had been made, it was found that a concrete pipe was practically as cheap as a riveted steel pipe of the same internal diameter, so concrete was decided upon because of its greater permanency and lower friction loss, as well as the less difficulty in securing construction materials. The design of a reinforced-concrete manifold to receive the discharge from the four pumps proved to be so difficult that it was abandoned in favor of a riveted steel manifold. The full-discharge velocity throughout the manifold and the concrete pipe was limited to 5 ft. per second, and in the design of the manifold an attempt was made to give the easiest flow lines possible while yet maintaining a form providing a maximum of strength. The manifold has a circular section in every part, and in order to insure additional stiffness a vertical plate is riveted in the crotch of the breech-like portion. No leak of consequence was discovered in any of this riveted steel construction.

Some concern was felt by the designers as to the probable pressure effect in the steel manifold and the concrete discharge pipe resulting from sudden closing of the hydraulic gate valves on the discharge side of the pumps. If, for any reason, power goes off while the pumps are in operation, the pumps almost immediately begin to run backward, and the water in the discharge



WATER FROM RIVER IS PUMPED THROUGH STEEL MANIFOLD AND REINFOCED-CONCRETE CONDUIT

pipe attains a fairly high velocity backward down the pipe. Checking this flow suddenly by the closure of the gate valve would cause water hammer. Calculations, based upon the various formulas tried, while not giving consistent results, seemed to indicate that no dangerous pressures would be developed. A small relief valve was, however, placed at the end of the steel breeching. In the operation of the plant and in the deliberate creation of conditions favorable for water hammer at the time of testing, scarcely appreciable rises in pressure were noted.

A vacuum relief valve was also placed at the top of the concrete pipe at Sta. 14 + 17, at which point there is a break in vertical alignment where vacuum conditions may be created by the rapid letting out of water from the pipe. The free area of the air valve is about 1% of the area of the pressure pipe.

Excessive temperature changes in the concrete and steel piping were anticipated, since, although backfilling over the concrete pipe was proposed, it was not of sufficient thickness to insure against considerable daily and seasonal temperature changes, while the steel piping was completely exposed. Expansion joints in the concrete pipe were considered, but the difficulty of construction and the possibility of leakage led to the rejection of expansion joints altogether in the concrete pipe and the placing of dependence upon the longitudinal reinforcement alone to prevent the formation of transverse cracks. It was planned also to construct the pipe in cold weather, and this was successfully accomplished by late spring, before hot weather had set in. No leaks of any magnitude have so far (April, 1918) appeared in the pipe although water was turned into it for the first time early in July, 1917, when there was probably 50° difference in temperature between the pipe and the water. Expansion joints were introduced in the steel piping of the manifold next to the pump-house, and the pump side of the joint was anchored securely to piers braced against the pump-house foundation.

The substructure of the pump-house is of reinforced concrete, designed to withstand a water pressure of 15 ft. The sump floors are designed to act as beams between the sump walls. The parts of the floor beneath the machinery were designed as beams heavily reinforced. Elsewhere the floor is 6 in. thick, well reinforced. The walls are 15 in. thick. The superstructure walls are of brick. They sustain a concrete crane girder, a 10-ton crane, and a flat roof supported by 12-in. I-beams. The roof is 3 to 5 in. of concrete on asbestos-steel corrugated roofing, and is covered with tar felt and gravel. The crane is provided with hand-operated lifting and racking mechanism.

Sump Drainage—Hydraulic Gates—Pumps

To drain the sump beneath each main pump unit, there is a 3-in. motor-driven side-suction centrifugal pump, with a valve-controlled 4-in. suction pipe. For priming the main pumps and the sump pump, a motor-driven rotary vacuum pump is provided, its suction being connected to a vacuum main from which branches lead to each pump. To the priming pump, immediately above each main unit, is attached a gage glass by which the operator can tell exactly when the unit is primed. Some difficulty was met in the initial operation of the priming pump, due to inexperience in adjusting the amount of water needed for water-sealing it. When finally adjusted, it would prime a main unit in from 5 to 7 minutes.

The hydraulic gate valves are 18 in. in size and are provided with a hand operating device for use when the pumps are first started and no pressure head is available in the discharge line for their operation. This device was found by no means satisfactory, since its design requires an entire dismounting before the valves can be operated hydraulically. The control of the hydraulic valves is centralized at a point near the switchboard, so that after priming a unit and starting the motor the operator merely turns a small pilot valve which opens the main valve. A reverse motion of the pilot valve likewise closes the main valve, so that the operation is very easy and rapid. Hydraulically rather than electrically operated valves were chosen because of their greater simplicity and much smaller first cost. Their operation in this plant has been eminently satisfactory.

Each main pump unit is an 18-in. double-suction split-case centrifugal pump with bottom horizontal discharge and vertical suction connection. The impellers are of bronze, and a bronze sleeve covers the shaft from the impeller out through the stuffing-boxes. The latter are water-sealed and were provided with bronze lantern rings.

Water for sealing was taken originally from the pumps themselves, which necessitated tightening the glands when priming. It is now proposed to utilize clear water from a spring near the station which will give sufficient water under pressure for water seal irrespective of the operation of the pumps.

The pumps are provided with ring oiling bearings in split babbitt cases. A flexible coupling attaches the pump to a 350-hp. induction motor on the same bedplate. These motors are three-phase, 60-cycle, of the squirrel-cage type, using current at 440 volts. Each motor is controlled from its own switchboard panel, the cable running in a conduit laid in the floor.

The switchboard is of standard slate construction and consists of six panels. Of these, four are motor panels, on each of which is mounted an ammeter, an integrating watt-hour meter, and the triple-pole single-throw oil switches. One panel is a totalizing panel, on which is mounted a totalizing wattmeter, a totalizing integrating watt-hour meter and a graphic recording frequency meter. On the sixth panel are a volt meter and the instruments of the auxiliaries and lighting circuits, comprising a watt-hour meter and the necessary single-throw switches for the house lights and auxiliary motors.

The current is transmitted to this station from the Preston substation, about six miles away, at 44,000 volts. Current is transformed into the 440 volts used at the plant by a bank of three 500-kva. transformers of the outdoor, oil-filled, air-cooled type. Four 44-kv. aluminum cell lightning arresters are provided for protection against line surges and lightning discharges, and the other equipment includes disconnecting and line switches, choke coils, expulsion fuses, etc. Serious difficulty experienced in times of electrical storms with high potential discharges on the secondary side, soon after operation was started, led to the installation of secondary arresters between the transformers and the switchboard, in addition to the more thorough grounding and transformer cases.

Tests

The contract between the pumping enterprise, or the Lewiston-Bear Lake Irrigation Co., and the Utah Power & Light Co., comprises many features intended to penalize peak-load conditions and to encourage an endeavor to economize on power consumption, although the base rate is only 1c. per kilowatt-hour. In the design of the plant, therefore, an effort was made to eliminate so far as possible hydraulic energy losses in piping and sumps, and in preparing the specifications an efficiency for the pumping units themselves of 81% was demanded. This figure was considered a not unattainable ideal, but one of the largest pump manufacturers in the country refused to bid upon the basis of this figure, and several other manufacturers were very loath at first to offer to attain this efficiency, particularly since the contract was so worded that a certain percentage of the contract price was to be withheld pending the attainment of the guaranteed efficiency. Inasmuch as this percentage amounted to $12,000, the contract provided for very complete tests of the pumps upon completion of the plant. Considerable thought was given to the matter of accurate water measurement. After rejection of other methods because of difficulty of operation or probable inaccuracies, it was decided to install a 14-ft. Cipoletti weir in the discharge canal, 200 ft. below the outlet of the discharge pipe and at the end of the concrete-lined section of the canal. The weir was constructed of 2-in. grooved and tenoned lumber with a thin steel plate for the weir crest, the weir being installed in a substantial concrete structure, with provision for removing the weir board upon completion of the tests. Heads on the weir were measured by a hook gage reading to thousandths of a foot, the zero of which was de-

termined by an engineer's level. Bazin's formula, as tabulated in Williams' and Hazen's tables, was used for calculating weir discharge. Although Bazin's formula is based upon the use of a weir without lateral contractions, it is recognized that the trapezoidal weir with side slopes of 1 to 4 gives a discharge "equal to that of the rectangular weir without end contractions"; hence Bazin's formula may be applied to the determination of the discharge of the weir in question and provides a very convenient method of computation, inasmuch as velocity of approach is taken into account in the formula and may be neglected when the weir conditions are comparable to those of Bazin, which it was the endeavor to secure in this case.

Pressure head on the pumps was determined by a calibrated Bourdon gage and suction head by a mercury manometer, both being referred to the axis of rotation of the pumps as a datum. Power input to the motors was measured at the motor terminals by an indicating polyphase wattmeter, current transformers only being used. Merely as a check, the readings of the switchboard instruments were taken during the test, but were not used in making calculations. Subsequent to the test the gages and electrical instruments were calibrated, and these calibrations were used in making the official calculations. In calculations of pump efficiency the motor efficiency was assumed as that shown by factory test at full load, 91 per cent.

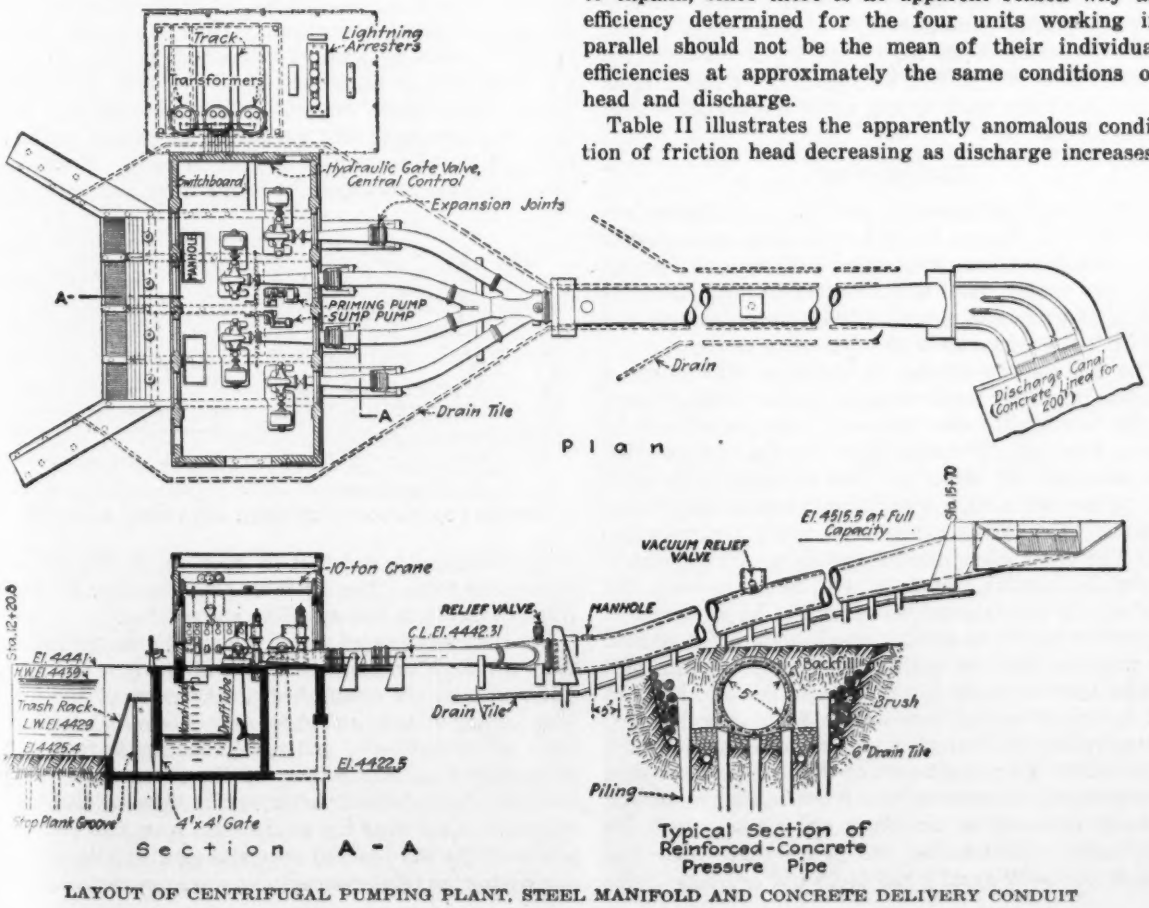
In testing (see Table I), the pumps were each run separately at three heads, the heads being varied by partly closing the hydraulic gate valves. Following the runs of the individual pumps all four were operated together to determine the action of the manifold as regards friction effect.

TABLE I. RESULTS OF CENTRIFUGAL IRRIGATION PUMP TESTS

Unit No.	Discharge Head, Ft.	Suction Head, Ft.	Total Head, Ft.	Static Lift, Ft.	Discharge, Sec. Ft.	Water, H.P.	H.P. Input	Pump Efficiency %	Speed
1	70.1	18.2	88.3	85.35	28.36	284.5	344.6	82.5	886
1	75.8	17.7	93.5	85.26	27.51	292.0	347.6	84.0	883
1	81.5	16.75	98.25	85.05	25.95	290.0	344.4	84.2	889
2	70.1	18.1	88.2	85.34	27.69	277.5	344.4	80.6	880
2	75.3	17.5	92.8	85.20	26.82	282.8	347.8	81.3	880
2	80.5	16.9	97.4	84.90	25.76	285.0	350.0	81.4	882
3	70.1	18.3	88.4	85.23	28.52	286.2	341.6	83.8	....
3	74.8	18.1	92.9	85.24	27.81	293.6	344.6	85.2	....
3	81.0	17.4	98.4	85.38	26.09	291.9	341.6	85.4	....
4	69.9	18.6	88.5	85.55	27.72	278.3	339.6	81.9	884
4	74.8	17.9	92.7	84.91	27.22	286.3	343.5	83.4	882
4	80.3	17.2	97.5	87.79	26.32	291.4	344.0	84.7	880
1, 2, 3, 4	71.1	17.4	88.5	85.8	108.01	1086.0	1421.5	76.5	

The most significant figures in Table I are those on pump efficiency. It will be noted that efficiencies of over 85% were attained by No. 3 unit, while all units are safely over the guaranteed efficiency of 81% at 90-ft. head. The lower efficiency of No. 2 unit is thought to be due to a small air leak in the suction pipe. This leak was not discovered until the tests had been completed. With all the pumps in operation there is noted a distinct falling off in pump efficiency which is difficult to explain, since there is no apparent reason why an efficiency determined for the four units working in parallel should not be the mean of their individual efficiencies at approximately the same conditions of head and discharge.

Table II illustrates the apparently anomalous condition of friction head decreasing as discharge increases.



LAYOUT OF CENTRIFUGAL PUMPING PLANT, STEEL MANIFOLD AND CONCRETE DELIVERY CONDUIT

This is probably due entirely to the better flow conditions established in the steel manifold when all four branches are discharging than when one only is being

TABLE II—FRICTION LOSSES BETWEEN DISCHARGE CANAL AND FOREBAY

Unit No.	1	2	3	4	Four in Parallel
Total static lift, ft.	85.35	85.34	85.23	85.55	85.8
Discharge head, ft.	70.1	70.1	70.1	69.9	71.1
Suction head, ft.	18.2	18.1	18.3	18.6	17.4
Total head, ft.	88.3	88.2	88.4	88.5	88.5
Friction head, ft.	2.95	2.86	3.17	2.95	2.7
Discharge, sec.-ft.	28.35	27.69	28.52	27.72	108.01

used, so that the saving of head here more than overbalances the greater loss in the concrete pipe due to the increase of velocity when carrying 108 second-feet.

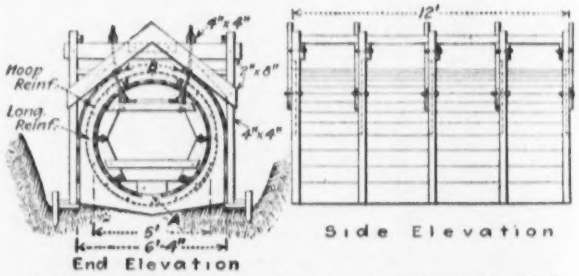
As a whole, the efficiency tests of this plant illustrate the recent very remarkable advance in centrifugal-pump design from the standpoint of efficiency, and give reason to believe that it is not too much to expect that in the case of large units, working under reasonably high heads, 85% efficiency may be obtained where the character of the installation is such as to warrant the extra expense of a pump designed for the special conditions under which it is to operate. It is to be noted that such efficiency can only be obtained by the use of small running clearances in the impeller at the wearing ring which prevent leakage from the discharge back to suction; and the water seal preventing air leakage into the suction passage around the shaft must be perfectly air-tight. Wear is to be expected in the course of time in the wearing rings, and the glands cannot be maintained in perfect condition after a long period of use, so that to maintain the high efficiency found when the installation is new it will be necessary to renew from time to time the wearing rings and the bronze sleeves on the shaft.

CONSTRUCTION

Active construction work was begun in September, 1916. To J. E. Wilson, Jr., of Logan, Utah, was awarded the contract for the pump-house building and foundations, the supply canal and all concrete structures, including the concrete pipe and the outlet, the weir and the various structures in the discharge canal.

The contractor's scheme of operation was to use a dragline excavator for the supply canal and for as much of the pump-house excavation as could be reached by such a machine. The excavation for the concrete pipe was attempted by teams and slip scrapers. The work had progressed only a short time when great and increasing difficulty was experienced with slides and cave-ins. The whole hillside was found to be in a completely saturated condition, and the site of the pump house and most of the supply canal was found to be underlaid to a great extent by an undetermined depth of quicksand. No progress could be made with the pipe trench until several lines of drain tile and brush drains had been put in and piling had been driven 5 ft. c. to c. almost the entire length of the pipe. Although the use of piling under either the pump house or the pipe had not been contemplated, the uncovering of the subsoil conditions made it necessary to use about 400 piles beneath the force main. Cave-ins in the pump-house excavation delayed the work greatly and increased enormously the amount of material to be moved. When the point was reached where concreting could be done it was midwinter. Most of the concrete in the foundation was placed when the thermometer never rose above freezing temperature. Forms frequently were overthrown or misplaced by cave-ins before concrete could be poured, and the water rose so rapidly in the excavation that a 3-in. centrifugal pump was kept going night and day. Nevertheless, in the face of such discouragements, the foundations were built and the superstructure was erected in time for the completion of the plant before the irrigation season of 1917 started. The pump-supply canal likewise involved serious difficulties in excavation, and it was found necessary to use side slopes as flat as 2½ to 1 to prevent slipping. This required the removal of excessive quantities of material and repeated dredging of the bottom, in order to establish a grade.

The construction of the concrete pipe involved form work of so interesting a character that it will be detailed. The hoop reinforcement was formed first to circular shape of the proper diameter, the ends being lapped about 18 in. and securely wired. It was then assembled in place and spaced by being wired to the longitudinal reinforcement. The inside form was then assembled inside of the reinforcement. The inside form was made in 12-ft. lengths, in six sections, five of which were bolted together at brackets. The sixth or top section rested on wedges supported on a cross-brace, and the whole inside form was hung by ½-in. rods, hooked on each end and attached to eye-bolts, passing up through 4 x 4-in. longitudinal stringers supported by the outside form framework. Thus the inside form could be raised or lowered into exact position by the adjusting nuts on these eye-bolts, the outside form first having been set to correct position and grade. The hoop reinforcement was supported in proper position by small blocks resting on the inside form. It will be noted that the bottom of the inside form was left open



FORMS FOR 5-FOOT CONCRETE DELIVERY CONDUIT

at A (see detail), and that an opening, B, was left in the outside form. The latter was held together by ½-in. bolts, to facilitate disassembling and moving.

Concrete was poured through a spout into opening B from a trough running the length of the pipe and supplied by a mixer established at the crest of the hill. The opening A gave an opportunity to see that the concrete was worked well underneath the inside form and completely filled the bottom of the pipe. After concrete had been poured partly up the sides of the pipe, the hooks supporting the inside form were removed and pieces of tin were tacked over the opening; the blocks supporting the reinforcement also were removed, so noth-

ing was left in the concrete to prevent the pipe from being perfectly tight, and no patching of the hole was necessary. Forty-eight feet of pipe was poured every alternate day. Care had to be exercised not to use too wet a mixture, as at the start some difficulty was experienced with the concrete running up through the bottom opening in the inside form.

The morning following the pouring of the concrete the first 12 ft. of inside section was taken to pieces and moved ahead through the other sections and reassembled. The other sections followed, until all were moved ahead and set ready for the pouring of the concrete the following day.

The conduit as finally completed was an exceptionally neat and smooth job inside, and when plastered with neat cement a surface was insured which, as subsequent tests showed, gave little frictional resistance to the flow of water. No leaks of any consequece developed in the entire length of the pipe—a mere sweating, which soon stopped completely, being noted soon after water was turned in near the lower end.

The joint at the junction of the concrete pipe and the manifold is worthy of notice. It is a section of steel pipe 5 ft. in diameter. A length of 3 ft. is bedded in the concrete block at the lower end of the concrete pipe, there being two 3-in. angles riveted around the steel pipe to act as cut-offs. The longitudinal reinforcement was passed through holes drilled in the flange of one of these angles and bent back to form a loop, thus being held securely to the reinforcement of the concrete pipe. No packing joint around the steel pipe between it and the concrete was provided, and no leak of any consequence has yet been noted at this point.

Design of Outlet—Contract Costs

The outlet at the upper end of the concrete pipe presented in construction some difficulties that were overcome. The curved interior walls are for the purpose of directing the flow of water as it issues from the enlarged end of the pipe so that it does not bank up against the outside wall.

To insure a minimum of leakage between the outlet and the measuring weir at the time of testing, the outlet canal for 200 ft. was lined with concrete. This has a thickness of 4 in., the bottom width being 12 ft. and the side slopes 1½ to 1 to a water depth of 4 ft. The concrete was laid in alternate sections about 12 ft. in length, and no special provision was made for joints.

The contract cost of the various items was as follows:

Supply canal, 23,485 cubic yards	$8,220
Pump house and foundations	13,534
Reinforced-concrete pipe and outlet	5,007
Delivery canal, 23,000 cubic yards	3,450
Light structures on delivery canal	3,461
All machinery and equipment, including erection	40,000
Total	$73,672

No extras of any consequence were found necessary on any but the first three items. The very difficult excavation for the pump-house foundations, concrete pipe and supply canal, and the greatly increased amount of material which had to be moved, due to slides and cave-ins, as well as the necessity of using piling under the pump house and pipe, increased the cost very materially. The final cost, therefore, of the completed project, including right-of-way, engineering and legal expenses, was $96,000.

The machinery and all the hydraulic and electrical equipment was furnished by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., through the Salt Lake Hardware Co., contractor. The erection of machinery was subcontracted to the Lynch Construction Co., Ogden, Utah. The concrete structures including the pump house and the supply canal, were contracted by J. E. Wilson, Jr., Logan, Utah. The supervision of the work was under the immediate charge of T. H. Humphreys, hydraulic engineer, Logan, Utah, and most of the detailed plans and drawings were prepared by the writer.

Mixer Association Standardizes Mixer Rating

Wet-Batch Capacity Is Taken as Basis After Careful Study of All Factors and Submission of Questionnaire

By G. B. Arthur
Manager, Concrete Mixer Association

IT IS not necessary in this day to argue the advantages of standardization to anyone engaged, as engineer or contractor, in engineering work. For example, the field would be thrown into utter confusion if an electric motor rating meant one thing to one manufacturer and another to someone else. Intelligent design, intelligent purchasing, intelligent operation are not possible so long as the producers of equipment fail to agree on standard methods of designating their product.

What is true of electric motors or steam engines is equally true of concrete mixers. The output of the mixer usually controls the speed of the job. Intelligent "planting" of work, so far as the mixing is concerned, is impossible unless there is a standard rating or the contractor fortifies himself with knowledge of all the fifty-seven varieties of ratings used by as many manufacturers.

Realizing the need and advantages of standardization, the Concrete Mixer Association has adopted a standard method of rating concrete mixers. This is based on the "wet batch"—that is, on the amount of mixed concrete which a mixer will discharge.

Standard Rating Not Absolute

The adoption of a standard method of rating may suggest that such a rating will be absolute, but this is impossible. A No. 7 mixer may mean a mixer which will discharge 7 cu.ft. of mixed concrete of given proportions. But when other proportions are used the output will be the largest batch which is consistent with the use of whole sacks of cement, although when cement is used in bulk the maximum output of the mixer can be obtained with any proportions.

A system of rating can be established only by taking a mixture of given proportions as a basis, with the understanding that this rating can apply only to the proportions specified, and that the output, when other proportions are used, will vary with the size of the batch, which in turn is determined by the method of handling

the cement. And while any rating should be expected to state the capacity of the mixer, this capacity might be either in terms of loose, unmixed material—called "dry rating"—or, according to the "wet rating," in terms of mixed concrete in one batch as discharged from the mixer.

The "wet rating" was adopted by the National Association of Mixer Manufacturers before that organization was dissolved to form the Concrete Mixer Association, and it became so familiar to buyers and users that any change in the method would seem like throwing away a certain amount of capital; at least, the careful work which brought about the adoption of the method could not be disregarded easily.

On the other hand, manufacturers who were not members of the old organization, and therefore were not consulted when the "wet rating" was adopted, were now to be considered, and most of these manufacturers had used the "dry rating." Some of them made chiefly large mixers, the others made only small ones. The former had much in common with the members who had been parties to the earlier standardization; the latter group, who sold many of their mixers to small contractors, farmers and other individuals, had an entirely different problem. A thought-provoking element in their selling is the principle that when a mixer receives a "dry rating" the buyer is impressed with the "bigness" of the machine and feels that the bargain is highly satisfactory, whereas if it receives a "wet rating," making the rated capacity one-third less, this reduction has its effect on the mind of the customer—he thinks he is not getting as much for his money.

Questionnaire Used

The standardization committee carried its investigation far enough to make a convincing recommendation, but action was deferred until a questionnaire was mailed to a representative list of men and organizations who would be likely to have a preference for either the "wet" or the "dry" method. When the replies were tabulated as in Table I it was seen that the preference was in accord with the report which was ready for presentation. It will be seen that of the 283 replies which were made 80% voted in favor of the "wet rating" while 20% favored the "dry rating."

TABLE I. RESULTS OF QUESTIONNAIRE ON "WET" OR "DRY" METHOD

Classification	No. Mailed	Replies Voting "Wet" or "Dry"	"Wet" No.	"Wet" %	"Dry" No.	"Dry" %	Replies Not Voting: Neutral	No Experience	Total Returned	Unclaimed
State highway officials	47	26	19	73	7	27	3	2	31	..
Cement companies	82	35	26	74	9	26	..	..	35	..
Engineering schools	109	32	28	87	4	13	2	3	37	1
Testing laboratories	20	6	5	83	1	17	..	..	6	..
Engineers and consulting engineers	200	72	66	92	6	8	1	..	73	72
Engineering societies	26	1	..	..	1	100	2	1	4	..
Editors of technical journals	6	2	2	100	..	..	1	..	3	..
Contractors	505	98	75	76	23	24	7	13	118	43
Other associations	15	11	6	55	5	45	..	..	11	..
Total	1,010	283	227	80	56	20	16	19	318	51

One factor probably outweighed all others and became the deciding one, when everything else had been considered: The advisability of using the "dry" method of rating could be disputed in the beginning because the volume of a batch of loose, unmixed materials when thrown together is a variable quantity, depending not only upon the kind but also upon the condition of the aggregates used. A careful reading of the replies which favored the "dry" method gives the impression that in the majority of cases this consideration was overlooked, the writers probably assuming that the volume of a batch of loose materials when thrown into the drum would be so nearly constant as to warrant its use as a basis for rating the mixer. It seems reasonably certain that, seeing that this is not true, many would change their preference to favor the "wet" rating.

As there is only one constant quantity available—the amount of mixed concrete which a mixer will deliver in one batch—the rating is established on this basis, with the following definition: "The standard association method of rating mixers shall be upon the basis of the quantity of mixed concrete which a mixer can deliver in one batch; assuming the use of one part cement, three parts sand and six parts 1½-in. crushed stone, with water at the rate of not more than 1¼ gal. to 1 cu.ft. of mixed concrete; the loose, unmixed batch to be approximated as 1½ times the mixed batch, or the mixed batch as ⅔ of the loose, unmixed batch."

A method of numbering was then adopted which requires that the size of the mixer shall be designated by a number indicating the capacity of the mixer in cubic feet of mixed concrete per batch, based upon the accepted method of rating. The practice of using the letters "S" and "E" to indicate side or end loading is discontinued, because in practice they seem to confuse rather than explain.

With these rules in force a No. 7 mixer can mean only one thing when found in the catalogue of a member of the Concrete Mixer Association—a mixer which will discharge, in one batch, 7 cu.ft. of mixed concrete of the proportions 1 : 3 : 6, using 1½-in. crushed stone, with water at the rate of not more than 1¼ gal. to each cubic foot of mixed concrete. The number 7 thus acquires much significance and becomes the natural beginning for a range of sizes of mixers.

Just before a war conservation program was put into effect in the industry the sizes 2½, 4, 5, 7, 14, 21, and 28 of building mixers were practically adopted for all members. But to conserve as much as possible the War Service Committee revised this, and the sizes 4, 7, 14, 21, and 28 in building mixers were recommended, with the understanding that manufacturers would put into these classes any mixers which were approximately of these sizes. In paving mixers the sizes 10 to 14 were recommended for adoption until it was possible to make the definition more particular. The tendency in the in-

TABLE II. OUTPUT OF CONCRETE MIXERS

Number of one-bag batches which will be discharged by mixers of different sizes, Concrete Mixer Association rating. (No. 10 is for paving mixer only) — Number							Proportions by Parts: Cement Sacks	Sand Cu. Ft.	Stone Cu. Ft.	Volume in Cubic Feet: Loose Cu. Ft.	Mixed Cu. Ft.
2½	4	7	10	14	21	28					
½	1	1½	2½	3½	5½	7½	1	1½	3	5.5	3.7
½	1	1½	2½	3½	5	7	1	2	3	6.0	4.0
½	½	1½	2	3	4½	6	1	2	4	7.0	4.7
½	½	1	2	2½	4	5½	1	2½	4	7.5	5.0
½	½	1	1½	2½	3½	5	1	2	5	8.0	5.3
...	½	1	1½	2	3½	4½	1	2½	5	8.5	5.7
...	½	1	1½	2	3½	4½	1	3	5	9.0	6.0
...	½	1	1½	2	3	4	1	3	6	10.0	6.7

dustries is to hold to sizes recommended by War Service Committees, as far as practicable.

Table II shows the output of these standard sizes for various proportions, and a little study of the variations in one-bag batches will throw all the foregoing statements into sharp relief. It shows also that the standards which have been adopted are practical and rational, and puts them beyond further argument. This table should be made a part of the information supplied for every job, to make sure that the mixer is doing all that should be expected of it; and these standards should not only make it easier to choose a mixer but should also go far toward safeguarding the integrity of the job.

Efforts to Consolidate the Engineering Profession

More Federation and Simplification Which Means Elimination Are Advocated—Problems Which Demand Solution Are Outlined

By A. D. Flinn
Secretary, Engineering Council, New York

THE organization of engineers in America is chaotic, complex and illogical. As consequences there are confusion, waste, inefficiency and dissatisfaction, which, however, are exaggerated in some minds. If no associations existed, it would be relatively easy to plan and create a system of organization that would satisfy demands much more effectively than does the present multiplicity of unrelated societies. But there have grown with the years traditions, and loyalties, and prejudices, clustering about the societies that now are. An answer to the problem thus created is not easy. To me the solution is not obvious, but some progress in the process is now appearing. There must be extensive consolidations, more federation and much simplification, each of which demands elimination. Steps are being taken, or preparations made for them, in various ways and places, and by a number of agencies. They will be accelerated as their benefits gain appreciation; but education, time, and patience are needed for attaining the goal.

The Problems Confronting a Consolidation Scheme

What are the present desirable limits to consolidation and federation? To what goal should they tend? By what methods and means can they best be brought about? These and similar questions are not being answered conclusively, because the necessary facts are not in hand. We have been muddling along in an unengineering fashion, attempting to plan and design and specify without a survey. On Sept. 12, Engineering Foundation by formal vote proposed to make the much-needed survey and preliminary studies, the four Founder Societies concurring. Of the necessity for this survey I have been more deeply convinced with the passing weeks, as I have listened to ineffective arguments and to misstatements based on ignorance which can be corrected only by the results of the proposed survey of engineering organizations.

Without the enlightenment of such a survey it now seems that the following elements of organization are desirable for the engineering profession in America: Excepting possibly three or four cities having large numbers of engineers, there should be in each community, having a sufficient group of technical men to be organized, one organization that embraces them all. Reasons for this are obvious. This organization may be an association of local societies and sections of national societies, or it may be a society admitting to its membership men of all branches of the profession. Examples of both forms of organization exist in a number of places. Local organizations should have large measures of autonomy, but should conform to approved types and standards.

Logically, the next step in organizing would be the combining of these local organizations into one or a few national societies, so that the loyalty, interest, comradeship, and activities naturally developed by the local organizations would flow to the national societies. But at this step the difficulties increase. Many engineers cannot become active members of local organizations, because of distances from headquarters; others do not desire local membership. If there were only one national society, many of the difficulties of scheming a system of organization would disappear; but there are, and probably for some years will be, several national societies of importance, and in each local organization there will be members of two or more national societies. A number of plans have been submitted to me for overcoming these difficulties. None is wholly acceptable. These problems lie at the bottom of the tasks of the Committee on Development of the American Society of Civil Engineers, and of the Committee on Aims and Organization of the American Society of Mechanical Engineers, and similar committees appointed by the other societies. Many engineers are giving them thought.

There are said to be approximately 400 organizations of engineers in America, of various kinds. Of these, about one-quarter are the leading national societies and their local sections. In general, the remaining societies have no official relationship, excepting the associations of local societies and sections in a few communities. Consequently, the engineering profession, before the public and Government, has no one organization which represents it as a whole, as have the medical profession, the lawyers, the chemists, the architects, the Chamber of Commerce and even labor. In the memberships of the Founder Societies, aggregating 35,000 engineers, there have been variously estimated to be only one-third to one-sixth of the total number of engineers in the country. The engineering profession lacks solidarity.

Not a little of the dissatisfaction voiced in various quarters as to the shortcomings of the national societies

grows out of ignorance or lack of apprehension of benefits actually received. In no small measure the complainants are at fault in not making better use of the facilities provided and the means of information put within their reach. Furthermore, some important benefits of membership in large technical societies are intangible and not capable of definition; not a few persons overlook these. Nevertheless, there are causes for reasonable dissatisfaction. The societies are endeavoring to remove these as they are recognized and remedies can be found. Humanity and its institutions will never be wholly rid of dissatisfaction, and to this truism engineers are no exception.

Quotes President Main's Address to Mechanical Engineers' Society

In this connection, a quotation from the presidential address of Charles T. Main to the American Society of Mechanical Engineers, December, 1918, is interesting reading:

In the *Monthly Bulletin* of the American Institute of Mining Engineers, March, 1918, there appeared the following:

"The vision dwells in the minds of many that ultimately these four great societies, lightening the emphasis they place upon their differences, may see the time when, for the solidarity of the profession, for their best interests, as well as for the increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation, freedom from individual development may be achieved through division along the lines of technical interests, which might either follow the present four grand divisions or be more minutely subdivided.

"An organization of this sort could and probably would be more strictly professional than any of the four have been heretofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring grave consequence."

This great vision is worthy of the most careful consideration and might be carried with safety to a point where the national societies would be gathered in under one executive head, without any one losing any vital portion of its individuality.

This would be a great step in advance and perhaps as far as we should go for some time to come.

Whatever scheme of organization be ultimately selected, it must be flexible, so as to meet successfully constantly changing conditions, and it must provide for both technical and social requirements of the membership, while maintaining high standards. "Social requirements," is here used to mean, in addition to social intercourse among members, services of the organizations to Government and to the public, and services to engineers individually, such as assistance in securing engagements and better standing in corporate and Governmental employment. Technical and social functions probably will be best kept distinct. Some engineers even suggest separate organizations; but at present prefer separate departments of one organization or of a federated group of organizations.

The United Engineering Society

So far as known, none of the leading organizations has stated a definite policy on these questions. Opinions herein expressed are only personal. The statements in this paper are merely a contribution to the general discussion of this subject by one who for several months has had especial opportunities for learning the opinions of others and gathering a little information.

As regards the joint activities of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, the present organization seems involved; and even some members of the governing bodies of these societies have difficulty in keeping relationships straight. It is, however, not so complex as some persons assume. It may be simply stated as follows. The four Founder Societies named have joined in creating the *United Engineering Society* to hold and administer property and to perform other broad functions for them. At their request the United Engineering Society has established three departments—the Library Board, the Engineering Foundation, and Engineering Council.

The Engineering Societies Library has possibilities for active usefulness to the engineering profession and to the industries of this country. Its present passive services are good and of great value, but the library can do much more. Funds are needed at once for complete recataloging of the books, for strengthening the collection of books, and for instituting new lines of service. The books of the societies have been brought together, but they have not yet been assembled as one library. Never, except during the war, has it been so important that all useful recorded technical information should be fully and quickly accessible to engineers—not only to those in the New York district, but also to those scattered throughout the whole land.

Engineering Foundation and Engineering Council

The Engineering Foundation now has an endowment of $300,000, yielding an annual income of $15,000. It rendered vital financial assistance to the National Research Council at the latter's inception in 1916, and for the year terminating in September, 1917. That council performed services of great importance to the Government during the war. For the future it already has in hand many projects. One of the most important of these is the promotion of industrial research, in which the Engineering Foundation is coöperating. The Engineering Foundation investigated a scheme for spray camouflage of ships; is conducting long-time tests on the wear of gears, and is making a research into the selective control of wireless communication. It has offered to undertake a "survey of existing engineering organizations, and from information thus developed to formulate a series of constructive recommendations which may be serviceable in guiding the further development of local and national engineering organizations, in their relations to the profession of engineers, to the public, and to one another." Other projects are being studied, but cannot yet be announced. Engineering Foundation's policy is to devote its energies and resources to undertakings of broad application, such as bringing about and stimulating coöperation among existing agencies engaged in research and outlining programs and organizations for research in specific fields.

The Engineering Council, since its organization meeting on June 27, 1917, has made progress in exploring its proper field of activity and fixing some of its boundaries. It has accomplished much useful but negative

work. In other words, its rejections have been important and have consumed much time. But there are noteworthy constructive achievements, also, on the credit side of its records. During hostilities the Council rendered no small aid to the Government through the American Engineering Service, which procured thousands of engineers for the War, Navy, and other departments, and through the War Committee of Technical Societies, which assisted the Naval Consulting Board and the Army General Staff in examining scores of thousands of suggestions for naval and military devices. Through efforts of its public affairs committee, the Council aided in having the military draft adjusted to permit the continuance of training in the engineering schools of the vitally necessary technical men. Through the industrial affairs committee vigorous opposition was offered to "anti-efficiency" legislation in Congress. Ten days after the signing of the armistice, the Engineering Societies Employment Bureau, with the four Founder secretaries as its board of directors, was substituted for the war-time American Engineering Service. The fuel conservation committee acted in a consulting capacity to the Fuel Administration and the Bureau of Mines in securing war economies, and is continuing its much-needed services into the era of peace. The water-conservation committee is prepared to promote right, and to oppose wrong, national or state Governmental actions relating to water-power or other utilization of water, by supplying statements of facts rather than joining in controversial support of or opposition to any particular measure. The license committee, with members judiciously distributed throughout the country, is collecting information on the licensing of engineers by the various states, and is preparing to render proper assistance in these matters whenever needed. The patents committee, coöperating with other similar bodies, is preparing important action for the improvement of the patent law and practice. During the spring and summer, the secretary visited groups of engineers representing the local societies and sections of national societies in 20 different cities from the Atlantic seaboard to the Pacific Coast. In 30 or more communities local correspondents have been selected for direct communication between Engineering Council and engineers at distances from headquarters. Furthermore, important projects of interest to all engineers are in preparation and may soon be announced. One of these is the formation of a national service committee, which is to have an office in Washington, as the representative of American engineers at the national capital.

All aims and endeavors of engineers through their national and local societies and their joint instrumentalities must be pervaded by a sincere spirit of service, not alone of one to another, but by all to the community, the state, and the nation. Such public service by engineers, architects, chemists, scientists, doctors, lawyers, and clergymen is our professional obligation, the *noblesse oblige* of a free and democratic people. Each profession has its distinct service to perform. In each profession there are big men and small men; each must contribute according to that which he has. Service is the only true stepping-stone to that eminence which alone is worth attaining. Greater opportunities have never opened to American engineers than those which confront them in these rapidly passing years of war and "reconstruction."

Committee Analyzes Track-Elevation Costs or Rock Island Work in Chicago

Book Figures Are Redistributed, Freight Charges and Other Elements of Expense Estimated and Added In, to Obtain Complete Unit Costs for Fifty Items on $2,700,000 Improvement

UNIT costs of the track-elevation work of the Chicago, Rock Island & Pacific Ry. have been the subject of an extensive study by a committee of valuation engineers. An organization known as the General Committee of the Chicago Zone Railways has been considering for more than two years the special valuation problems presented by the network of railroads in the Chicago terminal district. Between Aug. 1, 1912, and Dec. 31, 1916, track-elevation from 72nd St. to 90th St., a distance of 2¼ miles, was carried on by the Rock Island as a continuous operation, at a book cost of $2,703,196.75. The Rock Island completed an extensive study of the unit costs of this work, the results of which were reviewed and criticized by a subcommittee of the general zone committee, created for the purpose. The subcommittee is known as subcommittee 14, and Robert H. Ford, principal assistant engineer, formerly engineer track elevation of the Rock Island, is its chairman. The object of the investigation was to determine the correct methods for the distribution and probating of certain charges that appear on the books of the auditor, set up under account 43, later referred to, and the proper basis for estimating costs that do not so appear.

The report is divided into three books. Book 1 is simply an accounting analysis, or summary, of the auditor's records. Book 2 is an engineering analysis of the charges set up in book 1, which has been made for the purpose of obtaining the cost per unit of work. It embraces labor, material and work-train service costs as set up in book 1, and in addition freight on material over company lines. In this book the items in book 1 are analyzed and redistributed, and the units of work done allocated to the book charges for each class of work, such as filling, excavation and concrete. Book 3 is an addendum to the engineering analysis in book 2 and consists of added items of direct expense which affect the unit cost but which for various reasons have not been included in the book charges, these being added in order that the entire direct unit cost may be derived.

Book 1—Accounting Records

In book 1 the accounts are set up in conformity with the Interstate Commerce Commission classification—

(1) engineering; (2) land for transportation purposes; (3) grading; (6) bridges, trestles and culverts, and so forth. These are subdivided into the items of work—account 6, for example, containing 37 subaccounts, including such items as excavation, sand, cement, wood forms, drainage. Across the page these are divided into labor cost, material, quantity and cost, and work train hours and cost. The labor column includes only such labor as is covered by the pay rolls of the track-elevation forces. All amounts paid by voucher to contractors or others, whether for labor or material or both, are included in the material column. The material column does not include freight charges on the company's own lines. On July 1, 1914, the I. C. C. classification was changed to provide that thereafter such charges should be added on completion of the job, but as the work was still in progress when the analysis was being made the charges were not added in book 1. They were included in the material column in book 2. Under account 43, other expenditures and suspense, the company carried a large number of items that under a different policy would perhaps have been charged to other accounts, the company's policy being that doubtful items could better be classified upon completion of the work, after careful study. One hundred subaccounts, totaling $594,826.03, were carried under account 43.

Book 2—Engineering Analysis

The task in preparing book 2 was to subdivide and regroup the subaccounts of book 1 to cover actual inventory or physical units, adding in the computed freight charges for material hauled over the company's lines and allocating the suspense items in account 43, but otherwise retaining the I. C. C. classification. Thus, in accounts 3 and 6 the items for forms appearing in book 1 are incorporated in the concrete costs for book 2, and on the other hand the single item for concrete cribbing in book 1 is subdivided to cover the making and the handling and setting of two types of cribbing. "Drainage" in book 1 is replaced by "Drainage—4-in. Tile" and "Drainage—6-in. Tile" in book 2. Detailed statements of what the items in book 2 consist of, where the materials were obtained and how they were transported, are included in the report.

Numerous different bases were used in distributing the items of account 43 to the other primary accounts. General work-train service and repairs to material cars were allocated to benefited items in all of the other accounts, except engineering and land in the ratio of total costs of those items; handling material and general freight charges to benefited items in the same accounts as indicated above, in the ratio of the material

Item	Cost Unit	Book Cost Per Unit	Work-Train Cost Not Included in Book Charges	Various Omitted Items	Divisional Overhead	Total Unit Cost
Engineering	Per Cent	6.185%	.....	0.408%	0.680%	7.273%
Filling (including construction trestle)						
Gravel	cu. yd.	$0.690	$0.088	.....	$0.015	$0.793
Sand	cu. yd.	0.908	0.048	.....	0.018	0.974
Cinders	cu. yd.	0.806	0.047	$0.051	0.018	0.922
Filling (excluding construction trestle)						
Gravel	cu. yd.	0.604	0.079	.....	0.013	0.696
Sand	cu. yd.	0.823	0.040	.....	0.016	0.879
Cinders	cu. yd.	0.721	0.038	0.051	0.016	0.826
Construction trestle	lin. ft.	9.211	0.274	.....	0.179	9.664
Excavation—foundation	cu. yd.	0.996	0.043	.....	0.020	1.059
Shoring	cu. yd.	0.496	0.009	.....	0.010	0.515
	lin. ft.	1.062	0.189	.....	0.024	1.275
	sq. ft.	0.177	0.003	.....	0.003	0.183
*Excavation and shoring	cu. yd.	1.492	0.052	.....	0.030	1.574
Excavation—street	cu. yd.	1.017	0.016	.....	0.020	1.053
Concrete foundation piles	lin. ft.	0.955	0.010	0.007	0.018	0.990
Creosoted foundation piles	lin. ft.	0.562	0.011	.....	0.010	0.583
Excavation—caisson	cu. yd.	9.837	0.026	.....	0.186	10.049
Concrete—caisson	cu. yd.	4.982	0.196	.....	0.098	5.276
†Concrete — plain (forms in place)	cu. yd.	6.080	0.163	.....	0.118	6.361
Concrete — plain (traveling forms)	cu. yd.	5.192	0.155	.....	0.101	5.448
Concrete — reinforced	cu. yd.	8.737	0.218	.....	0.169	9.124
Column and girder incasement in place	cu. yd.	18.081	0.399	.....	0.349	18.829
Slabs and girders built in place	cu. yd.	9.025	0.221	.....	0.175	9.421
Column and girder incasement in yard	cu. yd.	15.745	0.603	.....	0.309	16.657
Slabs and girders built in yard, including handling and placing	cu. yd.	10.145	0.514	0.042	0.202	10.903
Concrete railing	lin. ft.	1.297	0.039	.....	0.025	1.361
Concrete cribbing ties						
Dowel type	sq. ft.	0.898	0.019	.....	0.017	0.934
	no. ties	3.167	0.068	.....	0.061	3.296
	cu. yd.	25.386	0.548	.....	0.490	26.424
Lock type	sq. ft.	0.618	0.009	.....	0.012	0.639
	no. ties	1.578	0.024	.....	0.030	1.632
	cu. yd.	25.411	0.359	.....	0.487	26.257

*Excavation and shoring for signal bridge foundation, $2.537 per cubic yard.
†Concrete plain for signal bridge foundation, $11.995 per cubic yard.

Item	Cost Unit	Book Cost Per Unit	Work-Train Cost Not Included in Book Charges	Various Omitted Items	Divisional Overhead	Total Unit Cost
Reinforcing metal	lb.	0.035	0.001	.....	0.001	0.037
Structural steel (not painted)	lb.	0.030	0.001	.....	.....	0.031
Waterproofing						
Joints	sq. ft.	0.067	0.002	.....	0.001	0.070
Walls and abutments	sq. ft.	0.017	.....	.....	.....	0.017
Decks	sq. ft.	0.250	0.006	.....	0.005	0.261
Drainage						
4-in. field tile	lin. ft.	0.126	0.001	.....	0.003	0.130
6-in. field tile	lin. ft.	0.316	0.003	.....	0.006	0.325
Gunite-steel incasement						
Floorbeams and box girders—1½	sq. ft.	0.108	0.003	.....	0.002	0.113
Expansion joints—2 in. thick	lin. ft.	1.279	0.036	0.003	0.025	1.343
Girders—2½ in. thick	sq. ft.	0.194	0.006	.....	0.004	0.204
Bottom floor slabs—5 in. thick	sq. ft.	0.314	0.010	0.001	0.005	0.253
Box girders—8 in. thick	sq. ft.	0.500	0.014	0.001	0.010	0.525
Box girders—filling	cu. ft.	0.244	0.007	0.001	0.005	0.257
Crossties—new, treated	no.	1.142	.....	0.512	0.031	1.685
Crossties—new, untreated	no.	0.808	.....	0.265	0.020	1.093
Switch timbers—new, untreated	ft. b. m.	23.195	.....	.....	0.438	23.633
Ballast						
Gravel base, 2 to 3½-in.	cu. yd.	0.743	0.086	.....	0.016	0.845
Gravel top dressing, ½ to 1½ in.	cu. yd.	0.885	0.090	.....	0.019	0.994
Cinders	cu. yd.	0.205	0.033	0.251	0.009	0.498
Tracklaying and surfacing						
Laying	miles	1274.64	218.94	.....	28.04	1521.62
Surfacing	miles	2591.32	17.01	.....	49.30	2657.63
Brick paving	sq. yd.	2.542	0.016	.....	0.048	2.606
Asphaltic macadam	sq. yd.	1.402	.....	0.240	0.031	1.673
Concrete sidewalk	sq. ft.	0.134	0.002	.....	0.003	0.139
Sewers						
12 in., depth 6 ft.	lin. ft.	1.519	0.001	.....	0.029	1.549
15 in., depth 6 ft.	lin. ft.	1.672	0.001	.....	0.032	1.705
6 in. catch-basin connections	lin. ft.	0.514	.....	.....	0.010	0.524
9 in. catch-basin connections	lin. ft.	0.706	0.001	.....	0.013	0.720
Manholes	no.	40.074	0.262	.....	0.762	41.098
Catchbasins	no.	47.546	0.031	.....	0.899	48.476

costs of those items; camp, repairs to small tools, to tool cars and to bunk cars, to benefited items in the same account as above, in the ratio of labor costs of those items; temporary trestle to "filling," account 3, and "concrete," accounts 3, 6 and 16, in the ratio of yardage; material yard items and temporary tracks to benefited items in accounts 3 to 27, in the ratio of weights of material; temporary tracks at source of supply of materials to "filling," account 3, "ballast," account 11, and all items in which sand and gravel were used in "concrete," accounts 3, 6, 15, 16, 26 and 27, in the ratio of yardage.

Book 3—Additions to Book Charges

Book 3, as previously explained, is an addendum of the engineering analysis shown in Book 2. "It consists," states the committee's report, "of added items of direct expense which materially affect the unit cost, but which, for various reasons, have not been included in the book charges." One element which is not included in these additions is general overhead charges—organization expenses; general officers and clerks; law; stationery and printing; taxes; interest during construction, and other expenses, general. Special studies have been made of the various items to determine whether the figures indicated in book 2 contain omissions. The same general classes of items, irrespective of the account to which they have been charged, are regrouped to show the average unit cost. Thus, the concrete items in the different primary accounts of grading, bridges, trestles and culverts, stations and office buildings, and so forth, were merged, but the different *classes* of concrete as plain, reinforced, etc., were kept distinct. On the other hand, certain items dependent on local conditions, such as station buildings, rail and other track material, were eliminated.

Engineering in book 2 was carried on a basis of percentage of all accounts except engineering itself and land, and was shown as 6.185%. Two additions were made in book 3. In connection with the inclusion of freight charges it was estimated that the additional work required the time of at least one accountant and one clerk during the period covered by the analysis, this amounting to 0.408%; the other addition was for divisional overhead, embracing charges for services of the chief engineer, bridge, signal, building and other staff engineers and their office forces. This was estimated by a special study to be 0.680%, and the two increments bring the percentage for engineering up to 7.273.

Special Studies

Following is the statement regarding the item for cinders. "Cinders have been included in the book accounts at an arbitrary rate of 20c. per yd. This is lower than actual cost, and an independent study is in process to determine the cost. Preliminary to this determination an estimated amount has been made based upon the switching rate directed by the Interstate Commerce Commission and the State Public Utilities Commission of Illinois, viz., 1c. per hundredweight (60,000 lb. minimum per car) to the originating line, plus ½c. to the delivery line, or equal to a minimum of $6 per car for the originating line, plus actual cost of handling on the delivery line, the latter being assumed as requiring four days' service for use of car at 35c. per day (demurrage rate then prevailing), plus the cost of switching, estimated as equivalent to 10 miles at ½c. per ton per mile. Computed upon 35 cu.yd. per car (which is the estimated average yardage of the loads of cinders covered in this analysis) and allowing 1500 lb. per cubic yard, the rates indicated above amount to $8.00 per car or 25.1c. per cubic yard. The difference between this cost and the arbitrary cost of 20c. per cubic yard or 5.1c. is added to class A cinders.

A special study of the cost of treated crossties resulted in an addition of 51.2c. per tie, the total cost including freight charges from the treating plant in Missouri to the distributing yard. Similarly, another study added 26.5c. per tie for untreated crossties.

Unit Costs Derived

The accompanying table shows some of the larger items—the unit costs (with freight charges) derived in book 2 and the estimated additions properly included. In some instances, costs in two or three kinds of units have been figured. In the use of the data, it is pointed out, judgment must be applied to evaluate the affecting conditions—not only the character and composition of the finished structure, but the hampering or facilitating conditions under which it was built. Thus, as concrete for retaining walls, it is pointed out, is ordinarily cheaper to place than concrete for abutments, because the work can be laid in larger sections, so all of the concrete work covered by the analysis is held to have cost less per yard than in the average track-elevation program in Chicago, partly because the right-of-way was less restricted and it was less difficult to prosecute the work and still maintain traffic, and partly because the Rock Island, having a large amount of concrete to place on the job, was especially organized for that class of work. On the other hand, it is thought that a similar study of track elevation on the Chicago & Western Indiana R. R., where filling is the principal item and the work has been organized for that, would show a much lower unit cost for grading and a much higher one for concrete. The report describes in considerable detail just what, as to materials and method of fabrication, was involved in each item, and the report, aside from giving a definite basis for fixing prices on the work it covers, aims to show the unreliability of undigested book costs, to suggest a method of analysis to determine correct figures, and to present a fair guide as to what those figures should be.

Besides Mr. Ford, chairman of the subcommittee, its members are Joseph Weidel, valuation engineer of the Santa Fé system; J. H. Roach, valuation engineer of the New York Central; E. B. Crane, assistant valuation engineer of the Chicago, Milwaukee & St. Paul; W. C. Bolin, pilot engineer of the Baltimore & Ohio; D. J. Brumley, valuation engineer of the Illinois Central; G. W. Hand, valuation engineer of the Chicago & North Western; A. Montzheimer, chief engineer of the Elgin, Joliet & Eastern, and L. S. Rose, valuation engineer of the Cleveland, Cincinnati, Chicago & St. Louis.

Supreme Court Fixes Responsibility of Contracts

Through oversight in the preparation of the article with above title published in our issue of Dec. 26, 1918, p. 1167, the author's name and title were omitted. The article was written by George A. King, of the Bar of the United States Court of Claims. Washington, D. C.

Emergency Shipbuilding on Lakes Handled By Erection Cranes of Many Types

Side Launching Imposes Special Requirements—Old and New Cantilever Cranes—Gantries Do Successful Work—Tower Cranes Installed During Past Year—One Crane Per Berth Now Thought Necessary

SHIP-ERECTION cranes of many forms are giving efficient service in the rush work of building ocean-going ships for the Emergency Fleet Corporation in the Great Lakes yards. Side-launching, which these

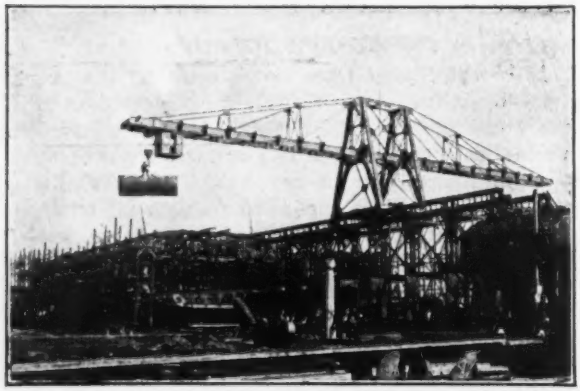


FIG. 1. DOUBLE CANTILEVER CRANE COVERING FOUR SHIPBUILDING BERTHS AT SUPERIOR YARD

yards practice exclusively, imposes on crane layouts and crane types requirements which lead to pronounced differences from the equipment found in the seacoast end-launching yards. As the building berth lies along a dock wall and the ship is launched over this wall, cranes and material cars can operate along one side only. This condition, and the common arrangement of grouping berths on a pier, have controlled the development of the shipbuilding cranes. Recent types, however, are such as to suit any berth arrangement equally well. The service obtained from the various cranes appears to depend more on the space layout of berth, craneway and storage facilities than on inherent characteristics of the cranes.

Revolving-jib traveling cranes are newcomers in the Lakes yards. Many have been installed during the past year. They are traveling portal-frame towers on which are mounted revolving locomotive-crane or equivalent superstructures.

All the cranes built for Lakes shipyards prior to the present year are either gantry or cantilever trolley bridges. These machines had proved entirely satisfactory, but as additional crane service was needed at once revolving-jib cranes, which could be obtained most quickly, were introduced.

While even the oldest of the trolley machines, as that shown by Fig. 1, are meeting the demands of rush work, evidence of progress is given by the fact that the more

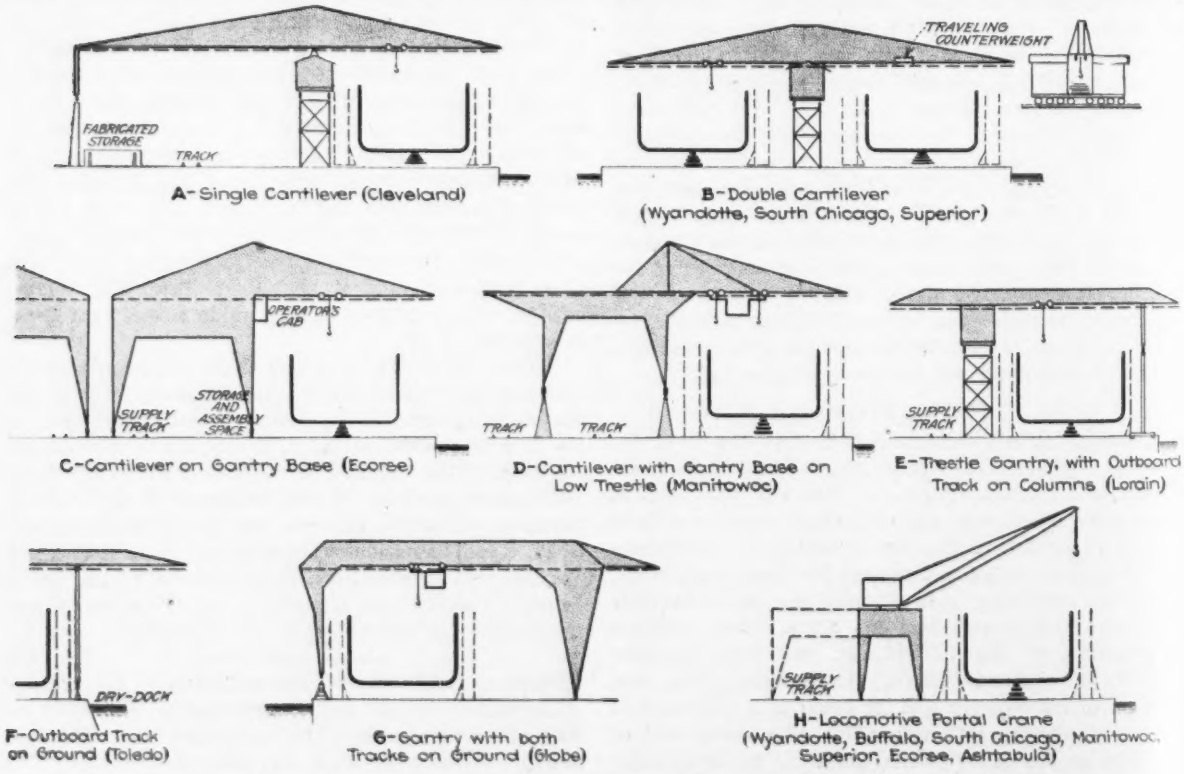


FIG. 2. SHIPBUILDING CRANE TYPES OF GREAT LAKES YARDS DEVELOPED DURING THIRTY YEARS
A-D, Single and Double Cantilevers; E-G, Gantries; H, Revolving Jib Cranes

FIG. 3. LOCOMOTIVE CRANE ON WIDE GANTRY BASE, IN SERVICE AT ECORSE

recent ones have proved superior in speed and operating convenience. The best speed records have been achieved in yards equipped with cranes of relatively recent design. It is noteworthy that the cranes which made the two fastest shipbuilding performances were designed by shipyard men; and one of these performances made a world's record for shortest time from keel-laying to launching.

Three Main Types Represented in Various Forms—Except for the revolving cranes of the present year, the Lakes yards are equipped with (1) cantilever cranes reaching out over the berth from its land side, leaving the other side clear to permit launching, or (2) gantries which span the berth and find support on an outboard track removed at the time of launching. The operation of removing and replacing the track, together with the fact that the berth is without crane service in the interval, constitutes a *prima facie* argument against the gantry type, but this is invalidated by the successful work of the gantries. Moreover, gantries as well as cantilevers are represented among the new cranes added during 1918.

A. C. Payton, superintendent of the American Shipbuilding Co.'s Lorain, Ohio, yard, where gantries have been used since the foundation of the yard in 1899, states that the cost of removing the outboard track to clear a 261-ft. ship is negligible, as a gang of 11 men does the work in 1½ days, and in any event part of this time is required for taking down scaffolding. He considers the Lorain gantries the best ship-erection machines on the Lakes. C. B. Calder, president of the Toledo Shipbuilding Co., Toledo, Ohio, is equally pronounced in favor of gantries, of which the yard has three; the cranes can go into service within two hours after a launching. The Globe Shipbuilding Co., Superior, Wis., which began operations during the past two years, has installed gantries as giving the most efficient utilization of the yard space.

Cantilever cranes are the oldest as well as the newest of shipbuilding cranes of the Lakes, however. Four different arrangements are in use, represented by sketches A to D, in Fig. 2. Trestle-supported cranes with cantilever arm projecting to one side (sketch A serve riverside berths at the Cleveland yard of the American Shipbuilding Co. Similar trestle machines cantilevering to both sides (B) form the equipment of berths grouped on piers at three other yards of the same company, at Wyandotte, Mich., South Chicago, and Superior, Wis. All these machines are about 25 years old.

Recent cantilevers are shown at C and D. One-side cantilever bridges carried on gantry bases running on tracks on the ground (sketch C) are used at the Ecorse, Mich., yard of the Great Lakes Engineering Works; the berths are on piers, and two cranes set back to back on separate tracks serve the two sides of the pier. The Manitowoc Shipbuilding Co., Manitowoc, Wis., has cranes of the same structural type, but running on low trestles 6 to 12 ft., high (D); the berths here are arranged along the river bank, and, as supply tracks are located both within the gantry width and back of it, the trolley runway is cantilevered out backward a short distance, so that it commands both tracks. A gantry-base double cantilever similarly supported on low trestles (Fig. 8) is in use at South Chicago.

Gantry cranes, used in three yards, are of as many different forms, distinguished by their track arrangement. At Lorain the outboard track is carried on a line of columns (E, Fig. 2, and view, Fig. 4). The Toledo gantries have their outboard track on the ground (F). Both these have a trestle to carry the main or inboard track, and the bridge has pin or hinge connections to its supports at both ends. The cranes of the Globe Shipbuilding Co., however, are of true gantry type (G)

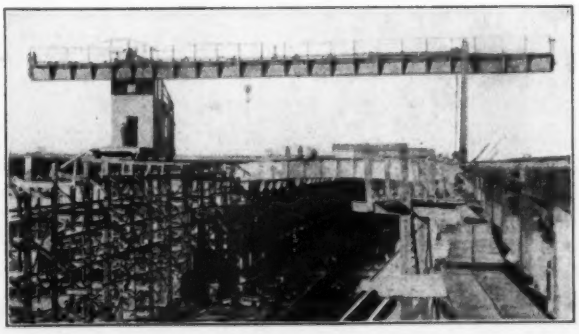


FIG. 4. ONE OF THE GANTRIES AT THE LORAIN YARD

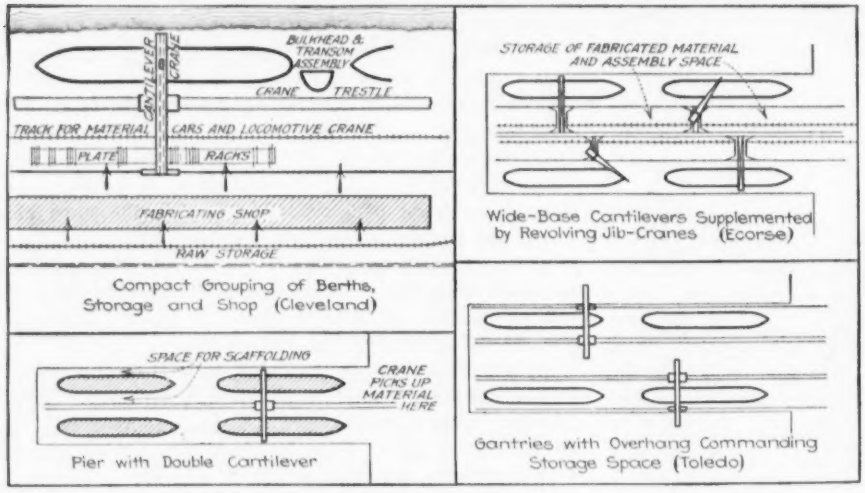


FIG. 5. STORAGE AND HANDLING OF MATERIAL AT BERTHS ARE AFFECTED BY CRANE TYPE AND ARRANGEMENT

and have both tracks on the ground. Removing and replacing the outboard track (and its supports, in the case of the Lorain arrangement) is in all cases done by the crane itself.

Revolving-jib cranes as installed during the past year comprise regular locomotive-crane superstructures, revolving on a fixed turntable seated on a portal-braced tower (sketch H). Even where the supporting tower is widened out to gantry proportions as shown by the dotted line (new cranes at Ecorse), the jib hoist does not traverse on the tower. Such locomotive tower cranes have been installed by the American Shipbuilding Co. at Buffalo, Wyandotte, South Chicago and Superior, to serve new berths; and by the Great Lakes Engineering Works at Ashtabula and Ecorse, and the Manitowoc Shipbuilding Co., to supplement existing cantilever cranes. One of these machine is shown in Fig. 3. A slightly different type of revolving-jib crane was adopted by the McDougall-Duluth Co. late last year in equipping its yard at Duluth, Minn.

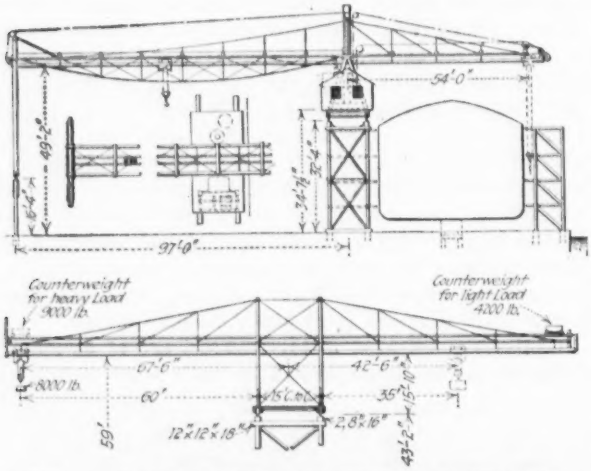


FIG. 6. EARLY SINGLE AND DOUBLE CANTILEVER CRANES STILL GIVING GOOD SERVICE

Old Cantilever Cranes Under Various Service Conditions—That the berth conditions and the arrangement of the surrounding space are of vital bearing on the results obtained from a particular crane appears in pronounced manner from comparison of the six old cantilever cranes to which reference has already been made—two one-side cantilevers at Cleveland, serving three berths, and four double cantilevers at Wyandotte, South Chicago and Superior, generally serving a group of four berths. All were built in the early '90's, and two of them are of the rod-braced light truss type characteristic of coal-handling machinery in that period. The Cleveland and Wyandotte cranes, Figs. 6 and 7, were built by the Brown Hoisting Machinery Co. for the F. W. Wheeler Shipbuilding Co.'s yard at West Bay City, Mich., and were removed from there later by the new owners, the American Shipbuilding Co. The Superior crane, Fig. 1, was installed about 1896 by the Wellman-Seaver-Morgan Co. when Capt. Alexander McDougall built his whalebacks at that yard.

At Cleveland the shop, berths and cranes are in closely-knit grouping, as sketched in Fig. 5. The shop lies directly back of the crane runway, and delivers either to the cranes or to storage racks in the runway. Material, therefore, has to move only a short distance in going from shop to ship, and a given crane capacity can erect more material than where a longer path is involved. Due to this fact, and also to unusually able and energetic management, the yard has been able to make an excellent shipbuilding record during the past two years, in spite of having much ancient, inadequate equipment and cramped facilities. Not only are the cranes old and of light capacity, and in need of very careful maintenance, but the shop, which is even older,

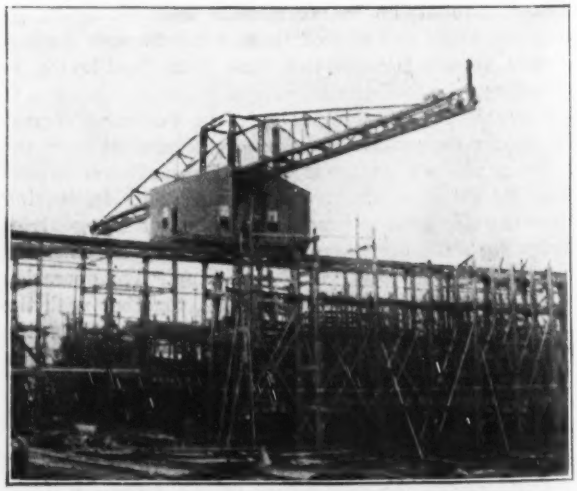


FIG. 7. WYANDOTTE DOUBLE CANTILEVER, ORIGINALLY AT WHEELER YARD, WEST BAY CITY

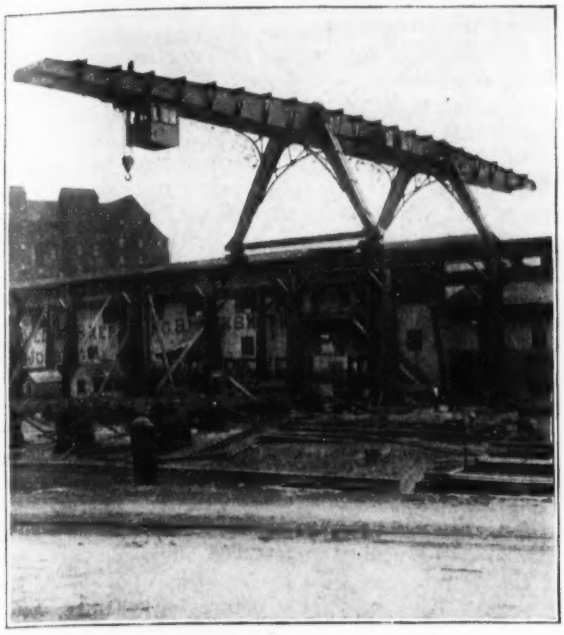


FIG. 8. UNEQUAL-ARM CANTILEVER CRANE ON GANTRY BASE, SOUTH CHICAGO

is badly cramped in layout and lacks handling facilities. The hoisting capacity of the cranes is three tons, and the speeds are: Lifting 250 ft. per minute, trolley travel 1000 to 1200 ft. per minute, bridge travel 300 to 400 ft. per minute.

Very different layout is found at the berths equipped with the double cantilever cranes, as Wyandotte and Superior. These are berths arranged in a group of four on a pier, down the center of which is placed the trestle of the double cantilever, as sketched in the small-scale plan in Fig. 5. No space is available for supply tracks between the ship and the crane trestle, or under the trestle. In fact, there is no way of bringing ship parts or other material from the inshore end of the pier except by the crane itself. Under this condition, and with only one hook for four hulls, these berths have crane service that is more limited than any other on the Lakes.

Experience in the South Chicago yard, where there is a Brown double cantilever similar to that at Wyandotte, is that shipbuilding on the berths served by the double cantilever is under a handicap in regard to crane service. Edward Morris, assistant superintendent of the yard, says that the crane is far from equal in capacity to the locomotive tower crane which has been installed to serve a new berth.

Surprisingly satisfactory service, however, has been given by the Wyandotte crane, according to the yard officials. A special method of operating the crane contributes to this. The crane platform is used as a magazine when material is handled from the shop to the berths, and this practice economizes in crane travel and saves time. Six or eight shell plates or other ship parts are piled at once on the truck platform of the crane carriage (see end elevation sketch at B, in Fig. 2) and are distributed to the ship in a single trip. While one plate is being run out on the trolley, the crane helper fastens lifting chains to the next plate, so that when the hook returns no time is lost in picking up a new load. The crane has a lifting capacity of 4 to 12 tons at speeds of 300 ft. to 80 ft. per minute; its trolley speed is 1000 to 1200 ft. per minute and its travel speed about 500 ft. per minute. It is reported to work as fast as the needs of the berth demand. At the time of writing, the yard officials were of the opinion that the double cantilever crane is equal in service to three of the tower cranes recently provided for the new berths of the yard, but called attention to the fact that the old crane has the advantage of skilled operators, the new cranes having been in service too short a time to have been brought up to best performance as yet.

An interesting change was made in the Wyandotte crane (Figs. 6 and 7) a few years ago. The traveling counterweight, which is equal to about half the maximum load capacity, was cut down to one-fourth or less of its original amount. Though this change decreased the stability of the machine, a 14-ton load has been carried at extreme reach without lifting the far wheels of the crane off the track.

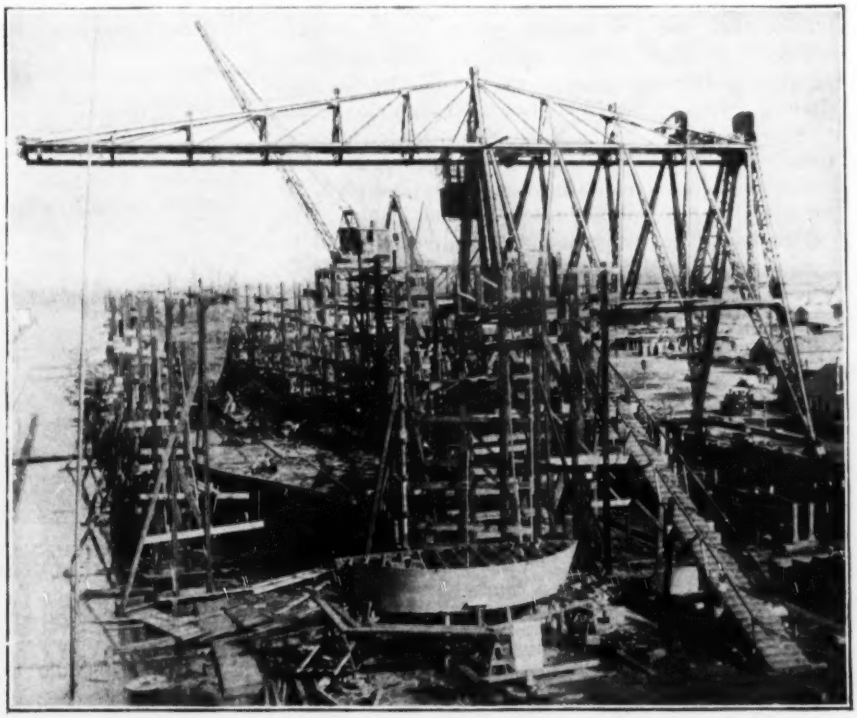


FIG. 9. GANTRY-BASE CANTILEVER AT ECORSE YARD

Another early cantilever, Fig. 8, shows more modern detail design, though built in 1898. Its trolley runway is supported by a gantry base resting on separate lines of columns. This crane is in service at South Chicago. Its structural parts are of plate-girder makeup, as commonly used by its builders, the Wellman-Seaver-Morgan Co. This machine, at present serving only a single berth, has been giving very satisfactory service. Its capacity is 10 tons, the maximum lift about 50 ft., the height of track rails above the ground 22 ft., and the total length of girders 195 ft. It was built for a Buffalo yard, and was later moved to South Chicago.

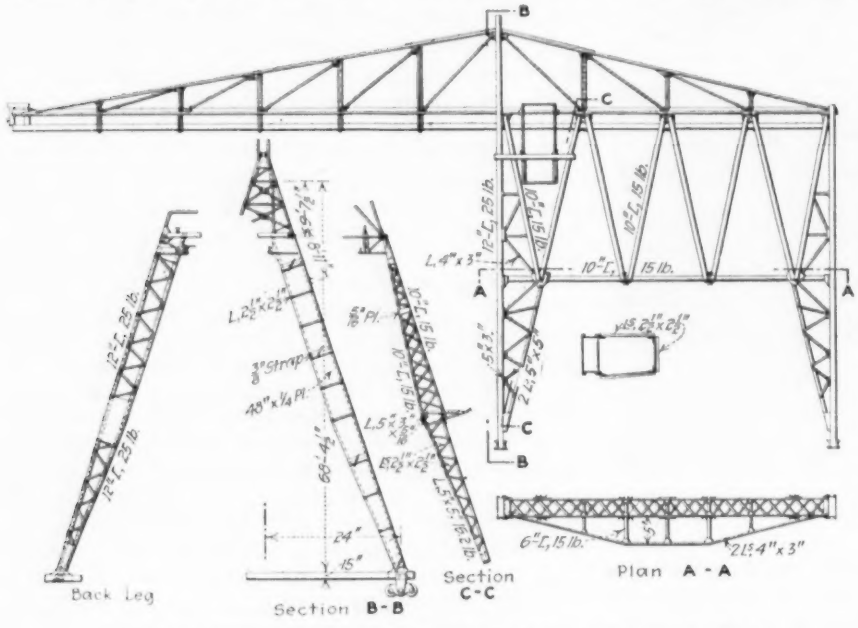


FIG. 10. OUTLINE DRAWING OF ECORSE CANTILEVER CRANE

Wide-Base Single Cantilevers Are Doing Fast Work—Remarkable efficiency was shown recently by the shipbuilding cranes of the Great Lakes Engineering Works at Ecorse, Mich., in building the 3500-ton steamer "Crawl Keys" in 14 working days. The berth system is such as to utilize most fully the advantages of short-travel material supply afforded by the layout. This feature, which was brought out in a description of the Ecorse pre-assembly system printed in *Engineering News-Record* of Dec. 12, 1918, p. 1076, is the determining factor in the performance of the cranes. The load capacity (seven tons) and the crane speeds compare closely with those of other ship-erection cranes in the Lakes yards.

The Ecorse cranes, Figs. 9 and 10, were originally designed by the Wellman-Seaver-Morgan Co., but the lower part has been rebuilt at the yard. Two were built in 1903 and the other several years later. Electric current for the operating motors is supplied by contact wires carried on short poles just back of the rear gantry leg. The control stand is in a cage at the forward end of the gantry frame, just under the trolley rail.

By combining the operator's cage with the hoist trolley, the Manitowoc Shipbuilding Co. has added a new operating feature to the gantry-base cantilever crane. The yard has four of these machines at present, all of them designed in the yard; the last was installed during the present year.

An old coal unloader was the starting point of the first crane, shown in the view, Fig. 11, Gantry legs were added to it, with the necessary travel machinery. The bridge was strengthened by trusses between the front and rear legs and by cable guys run from a frame erected over the forward legs down to the panel-points of the cantilever portion. An I-beam runway carries a two-hoist Pawling & Harnischfeger monorail trolley with operator's cage. This machine, built in 1903, has proved its value in the service it has rendered since then, and on the basis of this experience the same type was adopted for three new cranes installed during 1917 and 1918. Fig. 12 shows the structure of the latest of these cranes, built last spring by the Wisconsin Bridge & Iron Co. With forward and rear cantilevers of 80 ft. and 12 ft., it commands a supply area 59 ft. wide and a berth area 80 ft. wide. The two 1917 cranes, built for a double berth hitherto handled by the first crane, are of substantially the same design, but have a track gage of 58 ft., so as to be able to use the existing trestle. Berth 4, newly built, is served by the oldest of the cranes, transferred from the double berth, so that one crane per berth is provided, while berths 5 and 6, the newest, are equipped with a locomotive tower crane, which, together with a second one yet to be installed, will handle these berths and the adjoining fitting-out dock.

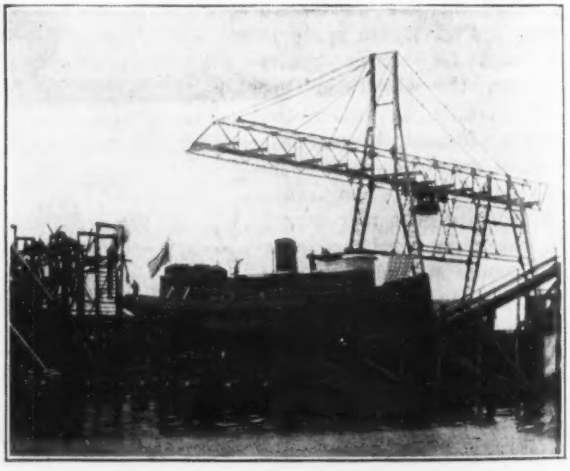


FIG. 11. CANTILEVER BUILT FROM AN OLD COAL-UNLOADING BRIDGE

A speed record in shipbuilding was made by the

Manitowoc cantilevers in July; on July 10 a keel was laid and on Aug. 7 the hull of the "Corsicana" was launched, after only 24 working days of building. Two cranes were used on the ship and a night crane force was run, but bolting and riveting were done only by the ordinary 10-hour day shift.

Gantry Cranes in Three Yards—During the same time exactly the same speed-record was made by the Lorain yard of the American Shipbuilding Co. The keel was laid July 1, and the fully riveted hull of the "Lake Deval," with tail shaft, propeller and rudder in place, was launched Aug. 8. Only one crane was available for this work. It was a gantry, of a type used at Lorain for 20 years. In a single 10-hour day this machine made 230 lifts, working up to its limit of speed, according to A. C. Payton and Charles Marlow, superintendent and assistant superintendent of the yard.

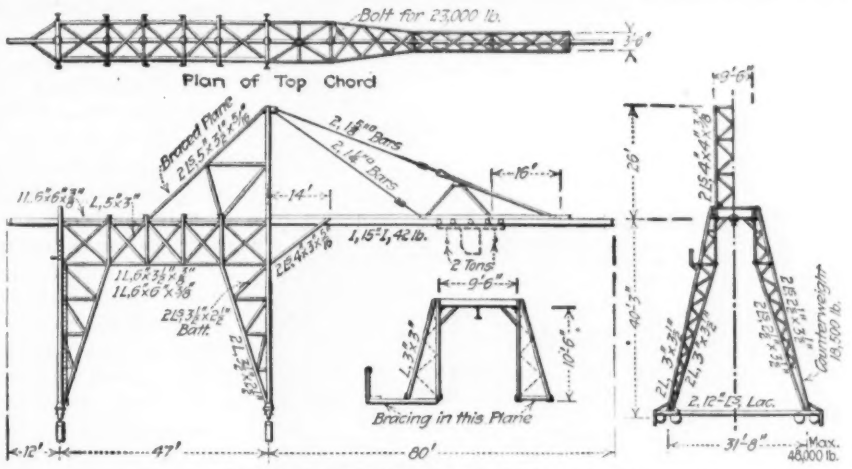


FIG. 12. NEW CANTILEVER CRANE OF MANITOWOC YARD

Berth conditions are substantially the same at all of the yards using gantry cranes. Material is picked up by the gantries from a rear cantilever extension of the trolley bridge in most cases. A few of the cranes have a span sufficient to cover a wide supply area alongside the berths.

Of the four gantries at Lorain, two built in 1899 and two in 1906, the later ones are represented by Fig. 13, from a drawing of the builders, the Wellman-Seaver-Morgan Co. The older cranes differ only slightly from these. Open-side main frame, gear drive of the travel wheels, and high travel speed distinguish these machines: trolley travel 250 ft. per minute, crane travel 500 ft. per minute. Steel columns support the outboard track of the 1906 cranes, while the earlier have 12 x 12 timber columns braced by the ship-erection scaffolding.

Figures on the time lost in removing and replacing the outboard track have already been given. The loss of time is reduced greatly at Toledo, where the crane serving a berth of reinforced-concrete construction has its outboard rail supported by an I-beam resting on chairs at a height sufficient to clear the fixed launching ways (see drawing in *Engineering News-Record* of Jan. 2, p. 9). Preparation of the ways, therefore, does not interfere with crane service.

At this yard three 10-ton gantries (Fig. 14) serve the six (short) berths. No speed records have been made here, but the gantries are specially interesting because of the flexibility of service which their design and location afford. They are designed so as to serve not only the berths which they cover, but also the dry docks which at this yard are used as launching slips (see sketch in Fig. 5). A 32½-ft. forward extension out over the dry dock enables the crane trolley to reach nearly to the middle of a ship in the dock. A rear cantilever extension of the same length covers a fabricated-storage and assembly space, and, as the layout of the yard gives a remarkably short straight-line route for material from receipt through the shop and to delivery opposite the ship, conditions for efficient hull construction are present. The travel speed of these cranes, however, is notably slow, being only 100 ft. per minute. A little boom is mounted on the gantry bridge to remove and replace the outboard track.

Two of the three machines were built by the Cleveland

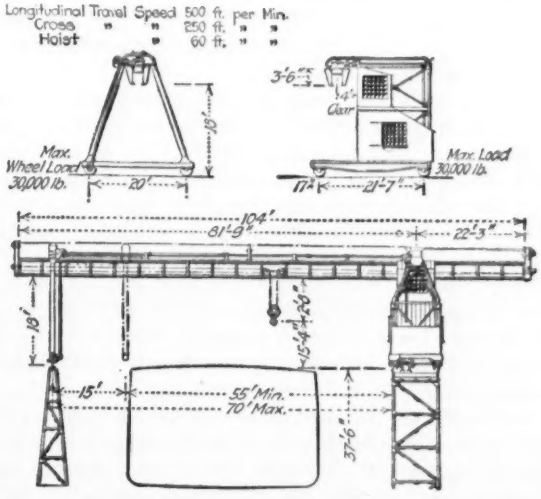


FIG. 13. GANTRY CRANES AT LORAIN EQUIPPED FOR HIGH TRAVEL SPEEDS

Crane and Engineering Co. about 15 years ago, while the third was designed and built by the yard. The spans are 75, 80 and 100 ft.; the long-span crane has no rear cantilever, as it is located close to the side property line, and has the storage and assembly space under the bridge, instead of back of the trestle.

The new Globe Shipbuilding Co. yard at Superior, Wis., has two gantries, which present an interesting difference in outboard rail supports. The first one built, of five tons lifting capacity, has its rail stringer seated directly on the cap timber of the dock wall. The launching ways, which rest on this same cap, cannot be placed until the stringer is removed. When the second crane, of 15 tons, was designed, this difficulty was avoided by raising the outboard track stringer on timber pedestals, about 3 ft. high. The ways can be placed

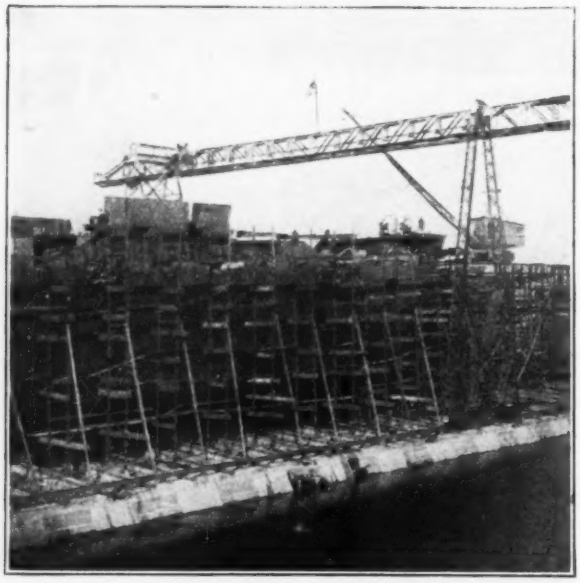


FIG. 14. TOLEDO GANTRY OVERHANGS DRY DOCK USED AS LAUNCHING SLIP

under this stringer between pedestals, and thus the crane can continue in service. James McKellar, general manager of the company, says that it takes about six hours to remove this rail before launching and about one day to replace it. The crane is operated up to within one day of the launch.

Ample width to cover supply tracks, storage and assembly space also distinguishes the newer crane. The first one is located so close to the side of the punch shop that the same arrangement was not practicable, and the inboard track was therefore placed close to the line of the scaffolding (Fig. 15); a cantilever extension of the trolley runway commands a supply track just inshore of the crane track. The new crane (Fig. 16) has a similar cantilever extension in addition to its large gantry width. Both machines were built by the Lakeside Bridge and Steel Co. of North Milwaukee, to outline designs of Mr. McKellar.

Some data of the larger machine are as follows: The span between the track rails is 100 ft., and its cantilever extensions are 18½ ft. and 43 ft. on outboard and inboard ends, respectively. The clearance height is 75 ft., the maximum lift 65 ft. Three speeds of hoisting and lowering are provided for, varying from 60 ft. per minute for a five-ton load to 20 ft. per minute for a 15-ton load. They are controlled from the cab, which, as in the Manitowoc cantilevers, is hung from the trolley, so that the operator has a direct view of his load. Power is supplied as 60-cycle three-phase current at 220 volts pressure. The crane travel drive is actuated by separate motors at the two legs. As the inboard leg carries about 60% of the total load with the trolley at midspan, and also takes all of the wind load, it was equipped with a larger motor; the drive has been found to work well with this arrangement.

Large-Capacity Tower Cranes Introduced This Season—In the pressure to increase crane facilities during the past year, locomotive tower cranes have become the dominant type of crane in some yards. The Wyandotte yard has its six new berths served by Link-Belt tower cranes, while the four old berths are served by the double cantilever crane previously described. One has been installed at Chicago. Ecorse has now four Orton & Steinbrenner tower cranes, against three of its regular cantilevers. Two McMyler-Interstate tower cranes have been added to the four cantilevers at Manitowoc. The McDougall-Duluth Co. yard has a tower crane of distinctive type, the superstructure being of derrick type; that is, only the boom and mast swing, while in the other machines the engine platform with boom is a unit, revolving on a center pin. The Duluth crane was built by the Clyde Iron Works.

One of the new gantry-base locomotive cranes at Ecorse is shown by the view, Fig. 3. It uses the same runway as the cantilever which hitherto served the two berths here. Each of the yard's three cantilevers has been supplemented by a machine of the kind shown, while berths 7 and 8, which are new, have been equipped with a locomotive tower crane alone, a narrow-base machine which will work from storage back of the track instead of between the rails. All four machines have booms 85 ft. long capable of lifting 3½ tons at full reach and 10 tons at 35-ft. reach. They are steam-operated, the boiler being oil-fired. With engines 9 x 10 in., they secure a high hoisting speed—110 ft. per minute with maximum load and 220 ft. per minute on single lines. The swinging speed is four revolutions per minute, and the travel speed 200 ft. per minute. The travel drive is actuated by double-friction clutches on the crankshaft of the hoisting engine. The super-

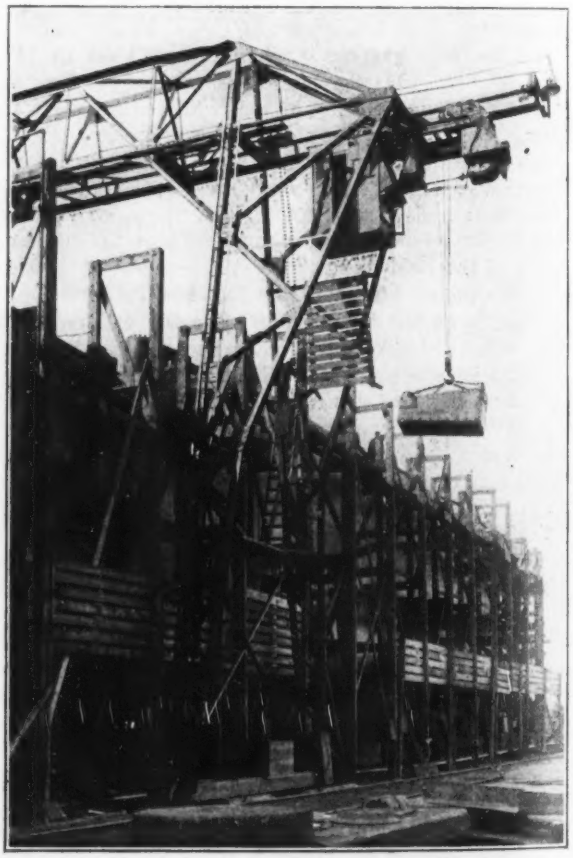


FIG. 15. INBOARD SUPPORT OF FIRST GLOBE GANTRY

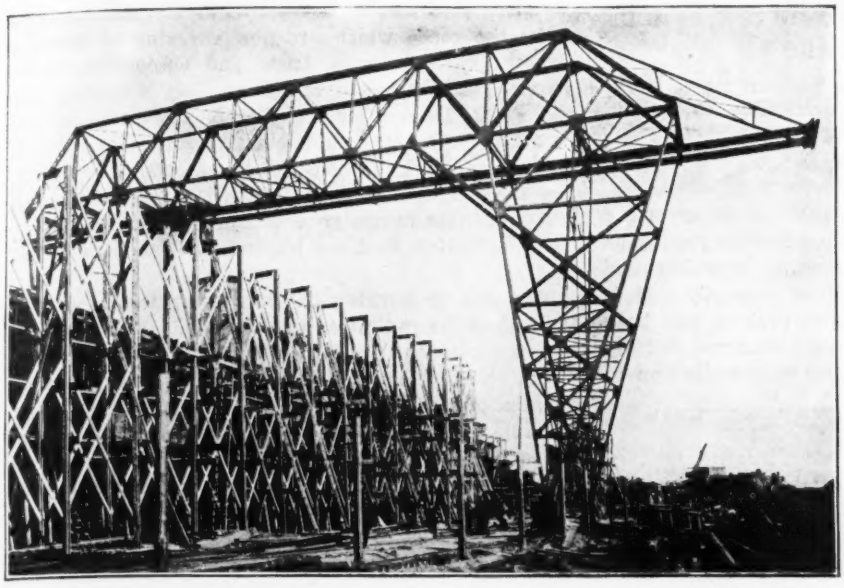


FIG. 16. LARGE GANTRY AT GLOBE YARD COMMANDS WIDE SUPPLY AREA

structure is simply the upper part of a standard locomotive crane of the same manufacturers. The turntable is formed of 28 chilled tread wheels 8 in. in diameter running on an 11-ft. circle of 60-lb. rail.

The Wyandotte cranes are of similar proportions, with boom length of 90 ft. and lifting capacity of about five tons at 50-ft. radius. A slightly more powerful machine

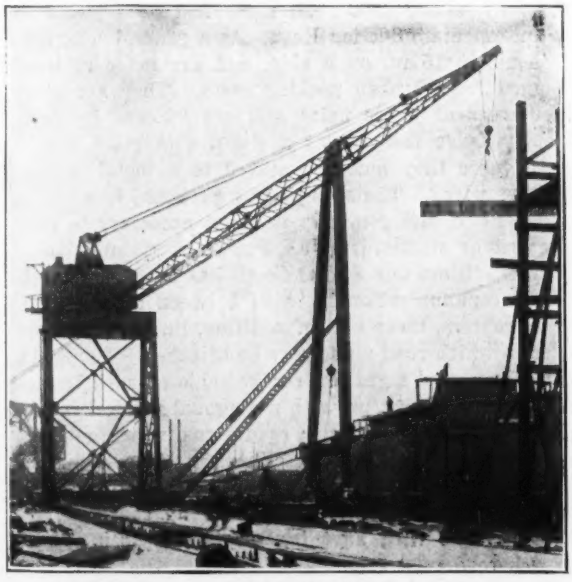


FIG. 17. LOCOMOTIVE TOWER CRANE RECENTLY INSTALLED AT ASHTABULA

has been installed at Manitowoc, and a similar one at Ashtabula (Fig. 17). The boom length of this crane is 98 ft. and the capacity at extreme reach is three tons. All engine parts are set by this crane, working at the fitting-out dock. Boilers do not have to be set at the yard, however, as the affiliated Manitowoc Boiler Works, about a mile away, has a river-front shear-legs for this work.

To carry on shipbuilding at maximum speed, as demanded by the Emergency Fleet Corporation's program, the erection equipment of all the yards, as well as other departments, required expansion. While the existing cranes in most cases were able to handle material fast enough to keep up with the *average* rate of shipbuilding during the past year, irregularities in material supply and fabrication frequently unbalanced the work sufficiently to call for a large excess, temporarily, of erection capacity. The pressure for output therefore led most of the yards to increase their crane equipment to practically double its former amount. All yard extensions made during the year have been provided with one crane per berth, and virtually the whole Lakes district will enter on the 1919 work so equipped.

Chinese, United States and Other Railways

China has 5193 miles of railways, according to a recent commerce report issued by the United States Department of Commerce, giving statistics for 1915. The lines under control of the Ministry of Communications aggregate 3703 miles (including the Hsuchow-Kaifengfu line completed in 1916), of which 150 miles are owned by private companies. Railways operated under concessions to foreign nations total 1490 miles. China has about 460 square miles of territory and 107,000 population per mile of railway, as against 40 and 8600 for India and 12 and 3800 for the United States. The report states that China's extensive system of canals tends to keep the proportion of mileage lower than in other countries. The locomotives on the Chinese government railways total 629, and are of various types introduced by the different nations which have built or provided capital for lines now forming parts of the national system. The necessity for standardization is becoming apparent, as the Chinese policy is to prolong the life of the engines by extensive repairs and renewals, partly on account of the heavy freight charges and agency commissions on imported locomotives. The passenger and freight cars total 1280 and 10,652 respectively. The freight cars averaged 69 tons per ton of capacity, or 69 loads per year, as compared with 99.3 for Japan and 23.7 for the United States. The average haul per ton was 89, 84 and 146 miles for the three countries, respectively. The cost of operation absorbs 53% of the total revenue; while 30% covers interest and other income charges. The remaining 17% is for the Government, of which 10% is the return on investment and 7% is business profit. The total investment is given as about $512,500,000, of which construction and equipment represent about $507,000,000. The total operating revenue for 1915 was $36,000,000.

Road Signs for Amexforce Trucks Save Gasoline

In the Army's Intermediate Section East, in France, It Is Almost Impossible to Take Wrong Route

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

A CERTAIN adjutant on the staff of an American brigadier general here in France has the reputation of being lightning-quick in detecting mistakes and letting their authors know of them promptly. It is only in exceptional cases, however, that he has been known to praise work. One of these occurred recently after he had finished his first long automobile trip in the Intermediate Section East. Returning to his general's headquarters he happened to encounter there the major of engineers who is acting as superintendent of roads for this district.

Photograph by "Engineering News-Record"

IN FRONT OF HEADQUARTERS SPECIAL SIGN INDICATES BEST ROUTES TO PRINCIPAL TOWNS

"Are you the man responsible for all those road signs which have been put up in this section?" he inquired. The major admitted that he was. "Well," replied the adjutant, "you've done a damned good job."

The marking of the roads in the Intermediate Section East of the American Expeditionary Forces has been carried out in a manner so thorough that one can now travel from one end of the section to another without once stopping to ask questions and without taking the wrong route. But while the new signs would justify themselves from the point of view of convenience alone, the important feature of this whole business is the enormous saving in gasoline which has been effected by the placing of wooden signboards at frequent intervals along the roads which are now carrying so heavy a volume of Army motor-truck and automobile traffic. Through the Intermediate Section East is moving, day and night, train after train of motor trucks, to say nothing of passenger automobiles, motorcycles and side cars. Gasoline in France today is a costly commodity, and it is imperative to conserve it in every way possible. In this campaign the road signs of the Intermediate Section East are playing a silent but effective part.

The plan of marking the roads embraces other features than the indication of direction. With the long-haul motor-truck trips which have now become so common, as a result of congestion of railway transportation, a train of vehicles may be on the road many days. Gasoline and oil supplies must be replenished en route, and occasionally it is necessary to know where spare parts and extra tires can be obtained. Special signboards are placed to give this much desired information. Then, too, in that part of central France covered by the Intermediate Section East, the old macadam roads were built primarily for slow moving traffic. Curves much sharper than would be considered good practice today are very common. Almost invariably they are built without any superelevation, and with the trees and foliage so general along French roads, one arrives at a sharp turn before realizing it. To prevent accidents at such points, all curves are marked by warning signboards located several hundred feet back from the curve, so as to give the motor-truck driver ample time to slow down.

In July, about 2500 road signs had been placed in the Intermediate Section East. As a general rule, they are squares, 15 in. on a side, and are made of wood salvaged from broken packing cases. They are given three coats of white paint and are lettered in black. When possible these signs are nailed in place, but in cases where they must be affixed to a metal support they are wired. The sign-placing problem, however, is a simple one, and generally it is not necessary to place any post or standard, as all French roads are flanked by trees. Since our Signal Corps has been busy establishing communication by wire between all important Army centers, there are, in addition, lines of telegraph poles to which road signs may be attached. The American Army road signs are recognizable as such because they are always set up with a diagonal vertical instead of like the existing French road signs, which generally have a rectangular form. When an American truck driver sees a white, diamond-shaped sign he knows that its message is for him. There is no confusing our Army's signs with anything else to be seen along a French road.

During a recent trip through central France with the superintendent of roads of the Intermediate Section East I had a good opportunity of observing how the roads have been marked. To begin with, there is in front of headquarters a large rectangular special sign, 4½ ft. long and 2 ft. wide, listing the names of the principal towns and indicating the best routes to them. One of these signs is shown in one of the photographs. On this sign the location of gas stations also is indicated. A driver entirely unfamiliar with the

VARIOUS SCHEMES OF LETTERING FOR ROAD SIGNS USED BY AMERICAN ARMY IN FRANCE

surrounding country can start at this sign and, without questioning anybody, proceed to any town in the section. If his gasoline supply should run low he would know where to replenish it, as a result of the information given on the headquarters signboard.

The matter of getting out of a French village and on to the main road leading somewhere else is no simple matter. The streets twist and turn in the most unexpected manner. A route that looks like a back alley may actually be the connecting link to the *route nationale* for which you are looking. On the other hand, you may, if your French vocabulary has not yet been recruited up to war strength, turn into a street with a name like *Impasse de l'Univers*, only to pull up sharply at its end when you discover that you have been navigating in a blind alley. Another confusing situation is presented to the motor-truck driver by the *place*, or square, which is abundant everywhere. Sometimes half a dozen streets radiate from one of these centers and when you try to choose the right one you begin to realize how overwhelming are the odds against you. I can think of no better way of describing the complex street plan of the small French town than to say that it follows lines that are as regular as those of a dish of Italian spaghetti.

There is one other point about the marking of roads over here which cannot be fully appreciated in the States. Take the case of a motor-truck driver arriving at a cross-roads. He may have two or three choices of route to follow, and all of them may appear to be main roads. Without road signs, what is he to do? The obvious solution would be to stop and inquire at the nearest farmhouse. This sounds simple, but in reality it is not. Many names of French towns as pronounced by the American truck driver mean absolutely nothing to the French peasant. The poor chap whose destination may be, let us say, Pougues-les-Eaux, or Monteignet-Escurolles gets in over his head when he tries to make known orally the name of one of these tongue-twisters. As one driver expressed it recently, after trying out his limited stock of French words on an old farmer whom be encountered plodding along the roadside:

"These guys can't understand you even when you talk to them in their own language."

Direction signs are placed at all crossroads and at intervals along all main routes. They are of several types, as shown in the drawing. If a town happens to be a "gas station" these words are placed in small letters above or below the name of the town. In addition to the direction signs are many others, of which the following are samples:

Road closed to U. S. Motor Vehicles.
U. S. Vehicles Must Not Cross This Bridge.
Bad Curves and Grades—Suitable Only for Passenger Cars and Light Trucks.
Slow! Railroad Crossing—300 Yards.
Loaded Trucks Use This Road.
Slow—Danger—Bad Curve—Sound Horn.

In the case of so long a title as that in the third group above the 15-in. diamond-shaped signboard is too small, and a larger rectangular one is employed generally for these special notices.

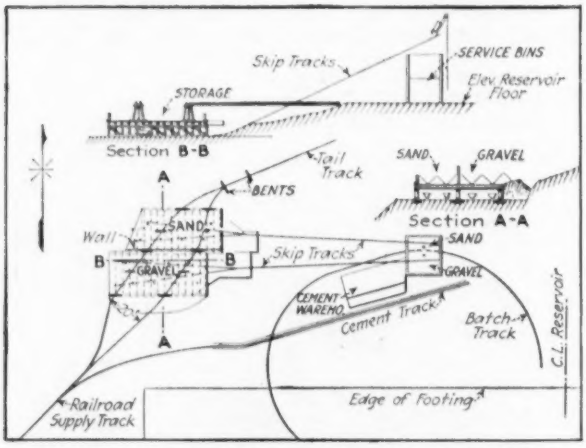
Photograph by "Engineering News-Record"
THE AMERICAN ARMY'S SIGN IS DIAMOND-SHAPED AND EASILY RECOGNIZABLE

Superintendent of roads for Intermediate Section (right) cooperates closely with the departmental engineering representative (left) of the *Ponts et Chaussees*

War Wage Increase Met by Revising Construction Plan

Concrete Output Multiplied Sixfold on New St. Paul Reservoir by Changing Method of Operating Traveling Mixing Plant

WELL-PLANNED plant met the handicap of labor scarcity and rising wages, in the construction of the new concrete high-service reservoir for St. Paul, Minn. Transportation was the governing operation. Not far from 150,000 tons of materials, including excavation, had to be moved. For the concrete structure alone 40,000 tons of materials had to be transported some two miles from the railway to the work. At the work these materials had to be assembled into a structure covering 2½ acres. By careful plant selection and lay-out, material handling both to the site and into the structure was made largely mechanical. Everything was put onto wheels. All raw materials were handled



CONCRETE MATERIALS FOR ST. PAUL RESERVOIR HANDLED HUNDRED PER CENT BY CARS

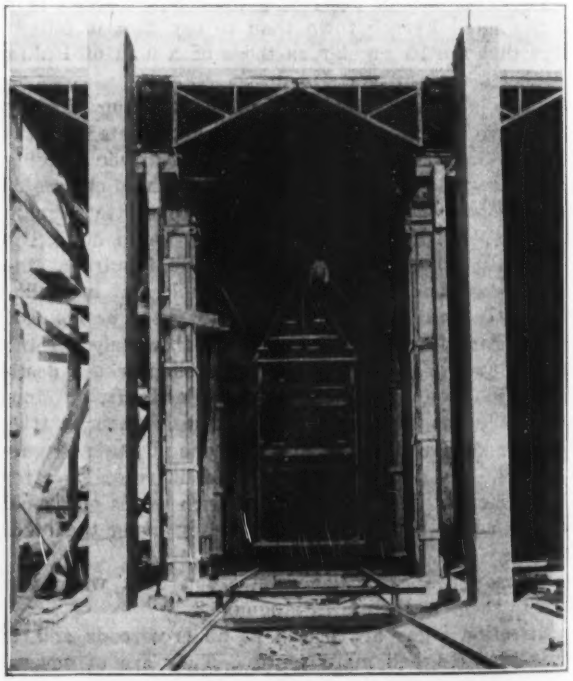
by cars. Concrete when not chuted directly into place was distributed in buggies over runways. The mixing plant was truck-mounted, and even complex forms for groined arches and buttressed walls were shifted by travelers on wheels.

The plans and structural details of the new reservoir were illustrated and described in *Engineering News-Record* of Nov. 15, 1917, p. 927. The plans provided for a structure 452 x 446 ft., so located that a second unit of the same area can be added when required. Structurally, the reservoir consists of an inverted groined arch floor carrying columns which support a groined arch roof. On three sides, the walls are inclined slabs braced by buttresses. The fourth side wall, which will be the dividing wall when the additional unit is built, is a cantilever gravity wall. Included in the main structure are gate chambers, aërator chamber, sluice gates, conduits, valves, etc. The roof and sides are covered and banked with earth.

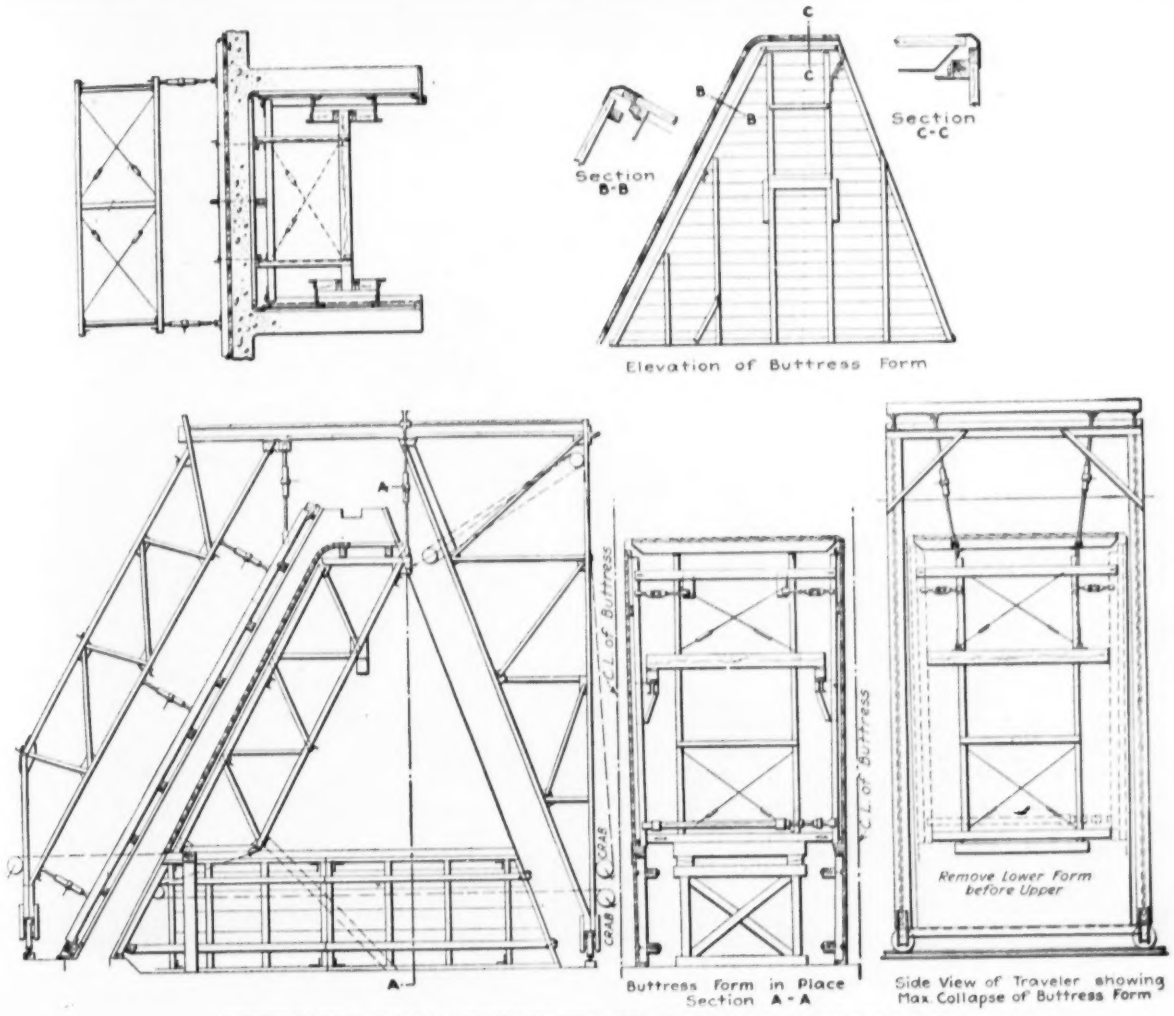
Located 300 ft. above city datum and two miles from the nearest railway, the reservoir site, despite its proximity to the city, was isolated in respect to available means of transportation. Estimates were made of the cost of tractor haulage. Including a necessary concrete road up the reservoir hill, a figure below $1.20 a ton could not be had. Surveys for a narrow-gage railway connecting with the contractor's yards and gravel plant on the railway two miles away, and passing a clay pit, gave a more reasonable figure, and the railway was built. It was 2¼ miles long, with a 1000-ft. trestle and a maximum grade of 2½ per cent. Turnouts and yard tracks at the reservoir were provided. The road cost $12,000, this figure not including rails and some other materials in stock. This railway, as events proved, did not reduce haulage cost below the original estimate, but it did cut down haulage time. Without it the construction probably would not have been completed in the specified time.

Construction began with the building of the railway and simultaneous excavation of about 90,000 cu.yd. of earth to level the site. Excavation was by steam shovel and narrow-gage cars, wasting the spoil on the sloping sides of the hill. About 32 days were required for these tasks. When the reservoir site had been graded the clay blanket was placed. In this blanket, and later for banking the walls and covering the roof, some 15,000 cu.yd. of clay was required.

All construction materials came in over the narrow-gage railway and was stored as indicated by the sketch map. Incoming tracks ran over the sand and gravel storage bins and to the cement house. From under the sand and gravel bins skip car tracks rose on a 50% grade to sand and gravel service bins with measuring hoppers. Under these bins and alongside the



COMPLEX WALL FORMS ARE MOVED SUCCESSFULLY BY TRAVELER



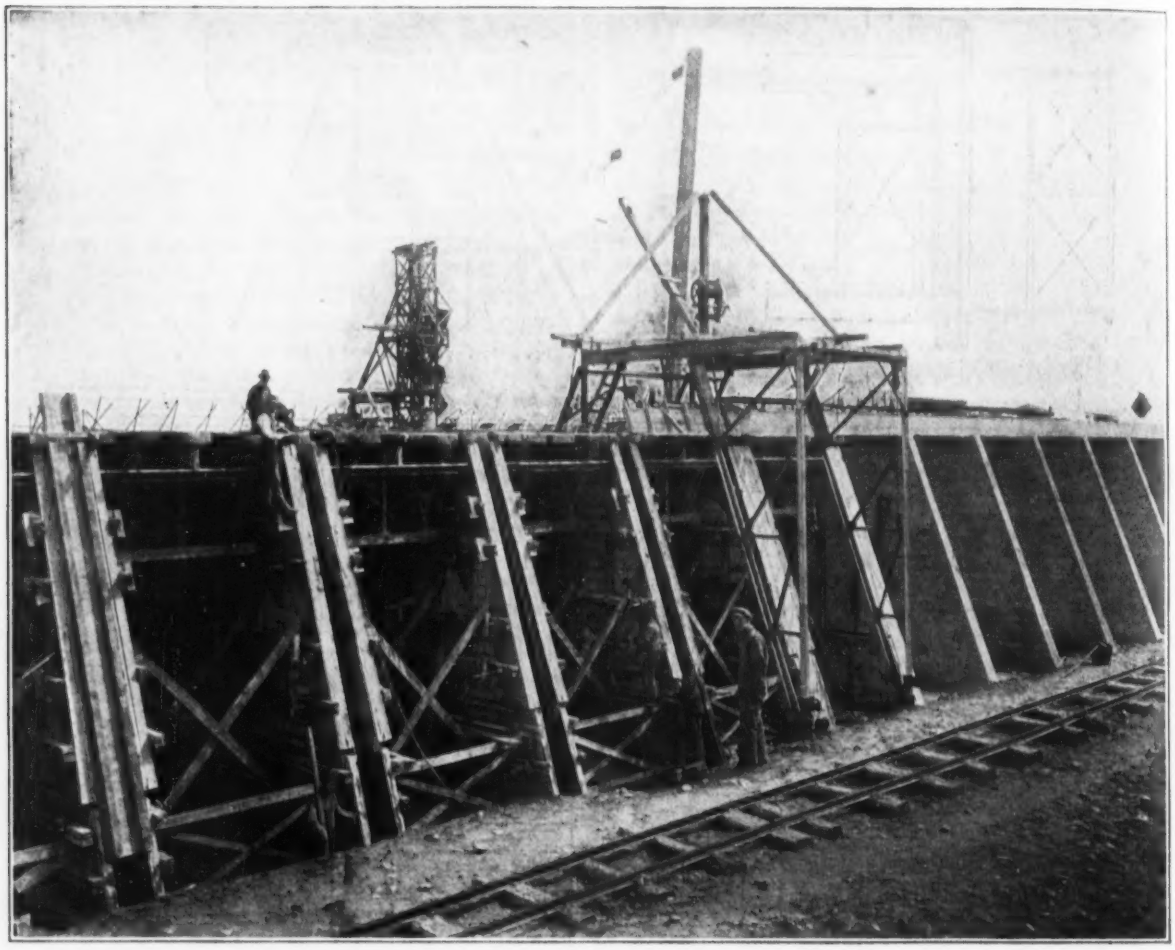
BUTTRESSED WALLS NECESSITATED COMPLEX FORM CONSTRUCTION

cement house ran the batch track to the traveling mixing plant. All batches were proportioned at the service bins and cement house in side dump cars holding each a batch.

Batch cars run to the mixing plant, which was mounted on a 16 x 22-ft. steel frame with a two-wheel truck at each corner and a wheel gage of 15 ft. From the platform rose a hoist tower, with a boom for supporting chutes. The tower bucket was charged from two 1-yd. mixers, which in turn were charged by an elevating skip into which the batch cars dumped. A 50-hp. boiler supplied steam to two hoist engines and to the mixer engines, all mounted on the steel frame.

The concrete was proportioned 1:2:4. At the beginning, empty batch cars returning from the mixer passed the cement house and there received their supplies of cement. Thence they passed under the service bins and received sand and gravel. With this method of loading, the cement stuck to the car bottom and gave trouble in dumping. To avoid this, a change was made by which the cement was added last. Trouble was then experienced from the cement blowing off the car in transit. The final change was to load first the sand, then the cement and finally the gravel. An inspector controlled the proportioning, from an elevated seat under the service bins. The measuring hoppers at the bins were like those described in *Engineering News-Record* of June 27, 1918, p. 1221. As originally planned, sand and gravel were dropped into the car simultaneously by one lever movement. When the order of loading was changed to sand first, then cement and then gravel, the hoppers had to be operated by separate levers. This was the only change found essential in the plant or the methods of handling raw materials.

The construction of the reservoir structure began with the concreting of the partition wall. First the footing was poured by direct chuting from the mixing plant running on a track parallel to the wall. When the footing was finished the mixing plant retraced its course and poured the wall proper. After the partition wall and a section of the connecting side wall at one end were completed, the mixer track was moved over a distance equal to three bays of the reservoir parallel to its first position. It was planned to complete the reservoir by repetitions of this operation. One condition which prompted this plan was that the specifications restricted chuting of concrete to a distance not exceeding 50 ft. The procedure in concreting



ROOF FORMS COLLAPSED, CARRIED AND ERECTED BY TRAVELERS

the first three bays was about as follows: The inverted groined arch floor three bays wide was poured for several days, by which time the forms for a group of columns had been erected. The mixing plant then backed up and poured the columns. It then moved ahead and resumed pouring the floor until the roof forms were in place on the columns first poured, when it ran back and poured the roof arches and such other columns as were ready. Shuttling ahead and back, the mixer proceeded until three bays across the east end of the reservoir were completed.

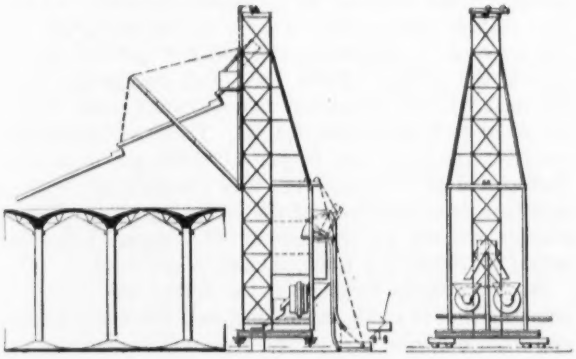
During the operations just described the contractor had been working with the material and labor market rising. A change of plan was necessary to equalize the wage and price increase. While this change was being planned, the mixer was set to concreting the wall footings all around the reservoir, and it had completed this work when cold weather set in.

Too frequent shifts of the traveling mixing plant to place a small yardage of concrete was the fault of the first plan of operation. Not only did the plant have to go ahead and back up several times to concrete the floor, columns and roof for a three-bay zone, but it had to be shifted sidewise, track and all, every 48 ft. During the winter the contractor sought by careful cost analysis a means of overcoming the fault. The outcome was a decision to place a permanent mixer track just west of the north and south middle line of the reservoir, and from this track to complete both halves of the concrete structure, spouting the middle 50-ft. zone and handling the concrete in buggies from mixer to forms for the remainder of the area. This plan was put into operation when work was resumed in the spring.

The procedure by the new plan was to concrete first the east half and then the west half of the reservoir. In detail, the operations were: The mixer, standing at the south end of the north and south track, poured, two rows at a time, nine rows of footings from the track east to the east wall of the reservoir. Concrete was spouted directly into the footings nearest the mixer and was wheeled in buggies on runways to the footing farther away. By the time nine rows of footings had been concreted, column forms had been erected on the two rows first poured. The mixer backed up and poured these two rows of columns, the buggy runways being supported on the column forms. Then the mixer ran ahead and poured two more rows of footings (rows 10 and 11). The form erectors then had ready roof forms on the two rows of columns first poured and also two more rows of column forms. The mixer then backed up and poured two rows of roof arches and two rows

of columns, and ran forward and poured two more rows of footings. These operations were repeated until the east half of the reservoir was concreted. Precisely the same procedure was followed in concreting the west half. By the sequence of operations followed, the concrete poured in each operation had time to set, the form erection was kept ahead of the concrete, and the mixing plant was continuously in operation. The time required to pour 24 footings was six hours; 24 columns three hours, and 24 roof arches 5½ hours. The maximum yardage poured in one day was 330 cubic yards.

The cost of placing concrete by the original method was $1.43 per cubic yard. Then the average yardage of the plant was 25 cu.yd. per day. In 1918 the plant averaged 155 cu.yd. a day. The cost is not available, but it can be stated that it has been considerably less than in 1917, notwithstanding the increased wages.



TRUCK-MOUNTED MIXING PLANT FACILITATED ZONE CONCRETING

When work was started in 1917 wages were on a 25c. per hour basis. In 1918 work began with an increase to 30c., then to 35c. and finally to 40c. Labor difficulties were not lacking. During the height of operations 175 men were required, but a two weeks' payroll had 527 names entered.

Form handling by means of travelers was employed whenever practicable. In building the partition wall timber sections 12 ft. long and the full height of the wall, 21 to 23 ft., were supported and moved by steel frame travelers which straddled the wall. Forms were set up for a 50-ft. wall section at a time, and a 50-ft. section of 150 cu.yd. was poured in six hours. This did not include footing, which was concreted in a separate operation at the rate of 25 cu.yd. per hour, or a 50-ft. section in eight hours. Side walls were concreted in step with the floor, roof and column construction previously described, except the footing slab, which was completed ahead of the other work. Chief interest in the side-wall concreting lies in the use of traveling forms for a complex wall design. The forms and traveler are shown by the drawings and picture. All of the forms were designed with care to economize in lumber by repeated use. Groined arch roof forms were like the wall forms handled by travelers.

The contract for the work was held by the George J. Grant Construction Co., St. Paul, Minn., which completed the concrete work Aug. 5, 1918, and the reservoir Oct. 1. The City of St. Paul furnished f.o.b. cars at the contractor's plant all cement, reinforcing steel, pipe and castings.

Fine Screens and Chlorine Meet Daytona Condition

Ample Dilution—Chlorine Removes 80% of Bacteria — Imhoff Tanks Elsewhere More Efficient Than Screens at Daytona

By George W. Simons, Jr.,
Sanitary Engineer, State Board of Health, Jacksonville, Fla.

PERFORMANCE studies of the Reinsch-Wurl sewage screens installed by the City of Daytona, Fla., in 1916, made by the State Board of Health, show that although the percentage of removal of suspended matter is only 7, yet fine screening, followed by chlorination, gives results at low operating cost which meet local requirements of discharge into the Halifax River. The percentage removal of solids would be higher if pumping and storage did not break up the sewage considerably.

Daytona sewage is almost wholly of domestic origin. Originally strong, it is highly diluted by ground water on its way to the screens. Ejectors at seven stations lift the sewage from half the area of the city over a ridge to the screening, disinfecting and main pumping station within the corporate limits of the city. For efficiency of pump operation, the sewage is stored in 560 ft. of 24-in. trunk sewers and in nearby laterals for some five hours, and is then fed to the screens and at the maximum capacity of the pump in operation at the time. Regulation is effected by passing the sewage through a small slot, the size of which is automatically controlled by a float designed by G. A. Main, superintendent. As the most remote sewer connection is less than 7000 ft. from the sewage-works, the sewage would be comparatively fresh were it not for the storage just mentioned. The septic action, combined with the previous agitation of the ejectors and the subsequent passage of sewage through the regulating slot, comminutes the original solid matter to such an extent that much of it passes the screen in a finely suspended or colloidal state, as is shown by the analytical data and also by tests with Imhoff conical settling glasses.

The raw sewage, as delivered to the screen, shows

TABLE I.—VOLUMES OF SEWAGE PASSING REINSCH-WURL SCREENS AND AMOUNTS OF CHLORINE USED AT DAYTONA

Date, 1917	Start of Pump	Length of Run, Hr.	Pumpage in Gallons Per Run	Pumpage in Gallons Per Day	Chlorine Used, Lb.
Dec. 1	7:00 a.m.	1.75	146,000	.....	1.5
	3:00 p.m.	2.00	166,000	.....	1.0
	9:00 p.m.	1.50	125,000	437,000	1.5
Dec. 2	5:15 a.m.	1.75	146,000	.....	1.0
	11:30 a.m.	1.00	83,000	.....	0.5
	5:45 p.m.	1.50	125,000	.....	1.5
	11:30 p.m.	1.00	83,000	437,000	1.0
Dec. 3	6:00 a.m.	1.00	83,000	.....	1.0
	11:10 a.m.	2.00	166,000	.....	1.0
	4:30 p.m.	1.50	125,000	.....	1.5
	11:45 p.m.	1.50	125,000	499,000	1.5
Dec. 4	6:20 a.m.	1.10	97,000	.....	0.5
	12:30 p.m.	2.00	166,000	.....	1.5
	5:00 p.m.	1.00	83,000	.....	1.0
	11:45 p.m.	1.10	97,000	433,000	1.0
Dec. 5	6:00 a.m.	1.50	125,000	.....	0.5
	2:55 p.m.	2.30	195,000	.....	1.5
	11:20 p.m.	2.50	208,000	528,000	2.5

upon evaporation (filter paper, etc., method) an average of 95.7 p.p.m. of suspended solids (800 lb. per 1,000,000 gal.) and 620 p.p.m. of dissolved solids—or 87% of the total solids content appears as dissolved solids or volatile matter. The same sewage showed 15 p.p.m. of nitrogen as free ammonia, 31 parts of total organic nitrogen and 142 parts of chlorine.

Sewage flow for 24 hours on May 23-24, 1917, with 335 house connections, was 280,000 gal., or 835 gal. per connection. Daily totals for Dec. 1-5, 1917, are shown by Table I. The average for these five days was 470,000 gal., or 1030 gal. a day for each of the 456 connections then in use. Some idea of the relative rates of flow during the 24 hours may be got from the records of intermittent pumping given in the table. On Dec. 6-7, when the pump was operated continuously for 24 hours, the maximum daily rate of flow was about 860,000 gal. and the minimum night rate was about 500,000 gal. All these records fall outside the winter tourist season and in comparatively dry weather, although there was rain on Dec. 5-6 and again on Dec. 6-7. The ordinary night flow is apparently ground water, at a rate of 100,000 gal. or more a day. This dilution increases the volume of sewage to be pumped and treated, and it affects the operation of the screen.

The Screen and What it Accomplishes

The sewage screen is of the usual Reinsch-Wurl overhung type, 8 ft. in diameter, with 5/64 x 2-in. tapered rectangular slots. The screen is driven by a belt at a rate of approximately 0.5 r.p.m. The rotating brushes move around the vertical axis of the brush shaft at a speed of 7.5 r.p.m. and revolve around their own axis at a speed of 37.5 r.p.m. The screen is placed in a pit at the pump station, receiving the gravity flow from the trunk sewer.

According to the specifications, "the screen will be required to remove from the sewage all solids sedimentable and nonsedimentable above 0.10 in. in diameter." The screen does this, but for reasons already stated a large part of this suspended matter passes the screen, the average suspended solids content of the screened sewage being 88.6 p.p.m., or 740 lb. per 1000 gal. On Dec. 6, 1917, an increase appeared in the composite samples representing the sewage flow from 5 to 11 p.m., sample collections being made every 15 min. Increases are not of regular occurrence, as decided reductions have also been made, as on Dec. 5, 1917. At this time composite samples representing the flow from 2:55 to 5:15 p.m., collected at 5-min. intervals, indicated a decided reduction.

The removal of screenings is the one real criterion by which to measure screen performance. During the pumping period, 2:55-5:16 p.m. Dec. 5, 3.67 cu.ft. of wet screenings were collected from 195,000 gal. of sewage, representing a removal of 18.8 cu.ft. or approximately 1080 lb. per 1,000,000 gal. From the pumpage started at 11:20 p.m. on Dec. 5 and continuing for 2.5 hours and again resumed at 6 a.m. Dec. 6 and continuing for an hour, 15.3 cu.ft. of wet screenings were collected per 1,000,000 gal. of sewage, representing the night flow. During these two periods a total of 291,000 gal. of sewage were pumped; 208,000 gal. from 11:20 p.m. to 1:50 a.m. following a heavy downpour of rain, and 83,000 gal. between 6 and 7 a.m. The influence of the rainfall can here be noted. The combined removal of wet screenings during the two periods representing the night flow was considerably less than during the period preceding, when there was no rainfall. The reduction of screenings following a heavy rain is made still more apparent in the following paragraph.

TABLE II.—COMPARISON OF SUSPENDED MATTER REMOVED BY IMHOFF TANKS AND R-W SCREENS

Raw Sewage, p.p.m.	Treated Sewage, p.p.m.	Percentage Removal	Place	Method
170.0	48.0	72	Eustis	Tanks
116.0	35.0	70	Mulberry	Tanks
201.0	85.0	58	Tampa	Tanks
95.7	88.6	7	Daytona	Screen

To get results with the screen operating continuously, a 24-hour test was instituted 11:36 a.m., Dec. 6, 1917. All sewage passing the screen was carefully gaged and samples were collected at frequent intervals. During this 24-hour run a heavy rain occurred which affected the flow curve decidedly, and 446,000 gal. of sewage passed the screen. From this total sewage flow only 4.7 cu.ft. of wet screenings were collected, representing about 10 cu.ft. per 1,000,000 gal. These wet screenings weighed 271 lb., or 608 lb. per 1,000,000 gal. of sewage. Unfortunately, no apparatus was available for making moisture determinations of the screenings. The screened sewage showed an average of 88.6 p.p.m. suspended solids, or 740 lb. per 1,000,000 gal. of dry matter.

As the sewage flows upon the screen the degree of comminution is easily noticeable, and the finely divided appearance of the screenings gives additional evidence of the disintegrating action. The sewage after screening is very turbid, high in suspended solids, but free of large particles which would have a tendency to float, despoiling banks and flats, and of a quality suitable for disposal into ample dilution water.

The wet screenings, which average 14.5 cu.ft. (2½ cans) a week are removed from the screen station to a dumping ground a mile west of the city limit by a negro who is paid 37½c. a can for this work.

Chlorination to Protect Oyster Beds

Chlorine is used to protect the oyster beds in the vicinity of the sewer outfall into the Halifax River. When the plant was first started the chlorine was supplied to the sewage, previous to the screening, at a rate of 20 lb. per 1,000,000 gal. of sewage treated. During the spring of 1917 the point of chlorine application was changed so that the greater part of the disinfectant was admitted to the chamber under the screen, a small portion still being admitted to the upper side of the screen. Bacteriological determinations made under the original plan (chlorine applied previous to screening) indicated a 75% reduction of all bacteria and a 90% removal of the colon type. At the present time, with the chlorine cut down to 5 lb. per 1,000,000 gal., there is an 80% removal of all bacteria.

For the year 1917 the cost of screen operation, including labor for removing and burying screenings and for other purposes and slight repairs, but with no allowance for power consumed, was $370. The sterilization cost for the year was $679.

Much has been said of late as to the relative merits of fine-screen and Imhoff-tank treatment. That there is a definite place for screen installations and a future

for fine screens is unquestionable, but screens will hardly replace tank treatment where refined results are necessary. Out of curiosity the writer has collected a few suspended-matter removals from Imhoff tanks in Florida, in plants treating sewage closely resembling that at Daytona. These results are shown in Table II. (See preceding page.)

With the usual Florida conditions—where fresh sewage is to be handled, quantities are small, flow is regular and ample supplies of dilution waters are available—the screen is more to be preferred than the tank because a refined treatment is not essential.

In conducting investigations at Daytona the writer has received heartiest coöperation and assistance from George A. Main, superintendent of the sewerage department.

Characteristics of War-Time Highway Work in Great Britain and the United States

War Conditions Have Been Injurious to Roads in Both Countries, and Immediate Maintenance Is Necessary—Each Has Recognized the Importance of Better Systems, Nationally Organized

This article has been prepared by an engineer who has seen the work of the United States Highway Council at close range and has also been in touch with highway work and highway control in Great Britain. A brief comment on this article will be found in the editorial pages—EDITOR.

NOW that peace is assured, it is apparent that one class of public works in need of immediate attention in this country and Great Britain is the public highway. In both countries it has been subjected to such excessive wear and inadequate maintenance, the investment in roads is already so great that the loss due to further neglect will be a serious economic matter, and it has been demonstrated that the utility of the roads during war times has so national an aspect that there, as well as here, a national system of highways is receiving serious study. Until the war laid its heavy hand on road work, the nationally economic value of main roads was looked upon in many quarters as theoretical rather than actual. The purpose of these notes is to point out how the war has nationalized road work on both sides of the Atlantic among English-speaking peoples.

PRE-WAR BRITISH ROAD WORK

Before the war Great Britain had made a small step toward national roads by the creation of the Road Board. This was formed in 1910 for the purpose of assisting financially desirable improvements in the highways of the United Kingdom. The influence of this board was directed toward the widening of narrow roads, the improvement of road intersections, the strengthening of bridges and the betterment of the pavements forming the roadway. The actual amount of money granted by the board has not been large, but its influence has been marked.

When the war broke out there were 150,000 miles of roads and streets in England and Wales, of which 33,600 miles were in cities and 23,800 miles were main rural highways. The funds for the road work were provided by taxes levied by the local authorities, by loans which required the sanction of the Local Government Board and which were equivalent to American bond issues, and, to a small extent, by funds supplied by the Road Board. The funds supplied by local taxation formed most of the appropriation for road building, and were not directly subject to national control.

In Scotland there were 24,900 miles of roads and streets. Here the financial management is more local, for there is no national board to control the making of loans for road work. The Road Board exercises practically all the national influence there is upon the highways of the kingdom; it is mainly advisory and coöperative.

In Ireland there were 58,300 miles of roads and streets, under a sort of dual control by both county and district councils. Here there is a Local Government Board which must give its consent to all loans for public works, so that the local financing of road work, not carried on by direct taxation, is under central control.

BRITISH WAR-TIME ROAD CONTROL

The financial features of road work in Great Britain during the war have been little understood in the United States, and as a consequence many erroneous statements have been made. It has been frequently stated that the British expenditures for road work have greatly increased; actually, however, the total funds made available for road and street work have remained practically stationary, despite the fact that large appropriations were made by the War Department and other agencies for roads having heavy motor traffic. The local authorities have continued to raise for road work sums which would be ample for their usual programs under normal conditions, but these sums have rarely been used up, and there are considerable accumulations available for work when conditions become normal. Practically no money has been raised for road work by loans, the Local Government Board stopping such bond issues, and the funds of the Road Board have been greatly reduced.

As soon as the war began, British road building received its most severe setback by the call for experienced road engineers and road builders for service in France. Just as some of the British railways had their rolling stock, rails and ties shifted to France almost overnight, so every highway resource in men and materials was sent across the Channel to maintain the roads which it was recognized at once were essential for military success. The first call was by no means the last, and the reports of the local authorities are practically unanimous in declaring that lack of skilled labor at any price has been one of the most serious difficulties in British road work since 1914.

This is a more serious matter in Great Britain than

here, because the normal road program is based on wages for experienced road men which are extremely low from our viewpoint. This is shown by a recent report from the authorities of Derbyshire, complaining that the minimum wages have been advanced to 20s. (about $5.00) a week, and there were 157 workmen receiving 25 to 30s. Even wages so high as to be unprecedented have failed to obtain needed men, and the following quotation from the latest report of the county surveyor of Worcestershire is typical of many such statements: "While there are considerable stocks of material in certain parts of the county, they are more or less concentrated on a few roads on which it was impossible to provide the labor. In some cases the material has been deposited on the side of the road for upwards of three years, and it is unfortunate to be compelled to watch a road seriously deteriorating while material is ready at hand."

A few attempts have been made to work German prisoners on the roads, but the results do not seem to have been satisfactory. The county surveyor of the eastern part of Suffolk recently reported that he had some prisoners on road work being done at the request of the military authorities. They were paid about 1½d. an hour; some were good workers and some were slackers. The results depended to some extent upon the man in charge of them, for they were not obedient to civilian superiors, and more attention had to be paid to their oversight than was the case with free labor.

By the end of 1916 it was apparent that the war demands for stone and gravel were so great that some method of rationing such materials was needed. Accordingly, the Road Stone Control Committee, composed mainly of experienced engineers, was organized to have supervision of their production and transport. It obtained from the local authorities statements of their requirements and from the quarry and pit owners of their facilities for production, also information regarding transportation facilities. Then the material needed for essential war-time road work was allocated, and the remaining needs were met in what seemed to the committee the most fair manner.

Complaints Against Restrictions

There has been some complaint about the restrictions placed upon local officials, but such complaints arise in times of peace as well as under the stress of war. One of the chief complaints has been that the committee forced some authorities to employ local stone, inferior to that previously used and brought from a distance, but the war-time demands for the superior stone and the limited transportation facilities in Great Britain during the war are held to justify such rulings. When the committee first exercised its authority producers of these materials were quite generally able to supply large quantities of them, and there was much criticism that prohibition of shipment was in some cases an unwarranted and arbitrary exercise of power. As time went by, it was discovered that such shipments would have been useless, because the labor for using the materials was not available, and those accumulating in stock were used elsewhere to immediate advantage. In other words, the comprehensive knowledge of the needs of the country which the committee possessed enabled it to foresee conditions better than the local authorities could.

The supply of tar for road work was also curtailed in 1917. In September, the Minister of Munitions directed that no crude or dehydrated tar should be used for the purpose, without a permit. The Explosives Department of the Ministry of Munitions allocated 52,000,000 Imp.gal. for 1918 road work, and entrusted its distribution to the Road Board. This quantity was later reduced to 47,000,000 Imp.gal., and the specifications were changed to allow a somewhat greater percentage of oils in the tar. This material has been used only on roads of national importance. As a matter of fact, the scarcity of labor in some districts has been so great that even had more tar been available it could not have been used satisfactorily. Attempts have been made to use women in tarring roads, but with only fair success.

War-Time Road Work Under Direct Control of Road Board

Strictly war-time road work has been under the control of the Road Board, to which the Army Council early delegated the following duties: (a) Arranging and supervising the construction and maintenance of new roads, and the improvement of certain private roads in several districts for military purposes; (b) arranging with local authorities for improvements on public roads, mainly at the cost of the Army Council, required for military purposes; (c) settlement with the local authorities for the Army Council of damages due to extraordinary traffic for military purposes; (d) similar duties for the Admiralty, the Ministry of Munitions, the Timber Supply Department of the Board of Trade, and for the Air Ministry. About $22,000,000 have been spent on such work since the beginning of the war; about three-fourths of this sum has been spent for the War Department.

The common belief in the United States that the British Government repairs all damage it does to roads, or pays for such repairs, is entirely wrong. The principle on which payment is made can be stated by quoting as follows from a recent report of the county surveyor of Nottinghamshire: "The damage done to the roads by the timber traffic has been considerable. Up to the present no satisfactory scheme has been inaugurated whereby the liability for the damage can be fixed on the responsible parties. Ninety-five per cent. of the timber is for national purposes, but the Treasury has so far declined to accept the responsibility for making good damaged roads, except those damaged by conveying timber on behalf of a direct Government department, it being left for highway authorities to take proceedings on the ground of extraordinary traffic against the person by or in consequence of whose order the traffic has been carried on." As such proceedings are very expensive, the local authorities are reluctant to begin them, for even if they are successful, the cost of obtaining an award will be so great that the net return is likely to be inconsiderable.

On account of the shortage of materials and labor during the war, most of the work done on the roads of Great Britain has been performed on main routes. The

impetus given to reconstruction and effective maintenance by the Road Board for a number of years prior to 1914 put the highways generally in good condition for any ordinary service. The county surveyor of Nottinghamshire reported a few months ago that the main roads under his care were in a very satisfactory condition, considering the general condition of public works.

In Aberdeenshire, where only one-third of the normal number of men can be obtained, the official report for the last fiscal year calls the road conditions very fair. In Essex, the roads have of late been kept in fair condition with the greatest difficulty only. There "efficient labor has been greatly reduced, whilst team labor in the ordinary sense has almost ceased to exist." In Kent and Worcestershire, the main roads have been maintained in fair condition, but they will soon need reconstruction. In Northamptonshire, a recent report states, the shortage of labor and materials has made maintenance very difficult, and extensive reconstruction necessary as soon as possible. In Gloucestershire, the conditions of labor, materials and traffic were such that it has been impracticable even to maintain some of the main roads, and highway conditions there are very poor.

If the occasion demanded, it would be possible to give many similar comments from comparatively recent reports of local engineering officials, regarding the British situation. It is unnecessary to do so, however, for these conditions have been summed up by the Road Board substantially as follows:

There is an urgent demand for the reconstruction of important roads to fit them for modern traffic. When the war is over a great number of motor trucks will be released for business uses. Roads must be built for the legitimate use of such trucks, but it should be stated here that there is the same complaint in Great Britain as in the United States about the reckless use of heavy trucks by military drivers. One county surveyor recently commented bitterly on the "unnecessary damage to road surfaces through the excessive speed at which Army motor lorries are driven, both empty and loaded." Another stated lately that where excessive damage has resulted from military and timber traffic, it has been almost entirely due to driving heavy vehicles in the same tracks without endeavoring to break wheel gage. There are strong indications that while heavy truck traffic will be planned for in Great Britain, the regulation of this traffic will be strict, and the taxpayers will have their investment in roads protected against the needless destruction caused by high speed and careless operation of vehicles.

Many Roads Must Be Reconstructed

It has been estimated by the board that about 15,000 miles of English and Welsh roads must be reconstructed for the traffic they will have to carry shortly. It is out of the question for local authorities to raise the money needed for this work and also for the other public improvements which are essential. The cost is estimated by the board at about $150,000,000. It is justified, the board states, by the fact that unless the main roads referred to are reconstructed to carry heavy traffic, as they become worn out, the annual cost of their repair and maintenance, as now built, will be greater than the total annual cost of suitable highways. This reconstruction of main roads is by no means all of the necessary expense at an early date in order to repair war-time neglect and place the roads in suitable condition for the traffic. About $6,500,000 must be spent on new roads and on widening old highways, and about $35,000,000 must be spent on bridge work in order to make the roads useful for the heavy vehicles which present structures are unable to carry. The total expenditure needed in Scotland is estimated at about $15,000,000. The same need of providing large sums for road improvements does not exist in Ireland, according to the Road Board, because the large volume of heavy traffic which has caused such destruction in Great Britain has not existed in Ireland.

American War-Time Road Work

It will not be possible to give any good summary of the effect of the war on roads in the United States until the state and municipal authorities make public the information concerning the work they would certainly have undertaken if not stopped by one cause or another incident to the war conditions. In a general way, however, anybody who has kept in touch with the road work here and in Great Britain has seen for some time one great similarity—namely, that the local officials agreed that the severe restrictions placed on their activities by the national authorities were marked by an excessive zeal in opposing local improvements. Probably this is perfectly natural, for the persons ordered to check construction in specified lines must inevitably be unpopular with those whose activities are hindered, no matter how carefully they may endeavor to minimize the hardships of the regulations.

The first war-time trouble in road building in this country was due to car shortage, just as it was in Great Britain. The difficulty was much greater here than there, however, because so much more road material is moved by cars here, and our coal situation was so much more acute than that in Great Britain. When the Government Commissioner of Priorities issued his order forbidding the shipment of road materials in open-top cars, except under special conditions, the bottom was knocked out of road work until arrangements were made for hauling such materials when empty cars were moving in the direction of the mines. This was a material help. A little later the demands for fuel oil became so great, and the prospect of still heavier demands was so good, that the Fuel Administration put its ban on the use of bituminous road materials. By this time it was apparent that some step had to be taken to enable important road work to proceed and to distribute the available road materials where most needed and where transportation could be provided. Accordingly, the late L. W. Page, director of the Bureau of Public Roads, suggested the formation of a committee representing all the Government agencies interested in any way in road materials and transportation, for the purpose of unifying all regulatory supervision of road and street construction and maintenance. The Secretary of Agriculture approved this plan and invited the Railroad Administration, the Fuel Administration, the War Industries Board, and the War Department to join with the Department of Agriculture

in the formation of a committee which would practically control road and street work through the control exercised by the departments and agencies named. The United States Highways Council formed in this way later had the coöperation of the Department of Labor and the Capital Issues Committee, and, as a consequence, was able to assist materially in overcoming situations similar to those which had previously led to the drastic orders of the Railroad Administration and the Fuel Administration, to which reference has already been made. If the work of the council has seemed oppressive at times, the conditions prior to its formation should be the criterion and not pre-war conditions.

Coöperation Given by State Highway Departments

The work of the United States Highways Council was only made possible by the coöperation of many of the state highway departments. All requests for materials had to be approved by the highway departments of the states concerned before they were considered by the council. Some of the state departments exercised great care in examining applications, and their recommendations were of the greatest help, it is understood. Even in such cases, however, war-time demands for materials or transportation made it impossible for some of the departments and agencies to furnish the assistance desired, and the applications had to be denied. Other state departments did not have the facilities for making such complete investigations, and as it was physically and financially impracticable for the council to investigate every application through the resources at its command, many of the applications were doubtless delayed seriously by the correspondence necessary to establish the facts.

The outstanding facts concerning the work of the council seem to be these: Before it was established, road construction and maintenance were in a fair way to be stopped. As soon as it was established, the conditions under which road materials and transportation could be furnished were explained, and the state highway departments were not only notified, but were asked to coöperate by passing upon all projects in the light of the conditions outlined by the council. This was in line with the action of the Road Stone Control Committee in Great Britain. In both countries the central authority apparently desired to utilize the knowledge and resources of the local authorities to the utmost. The coöperative idea was carried much farther here than in Great Britain, however, and it is believed that, when the extent of the countries, the mileage of roads and streets and the quantities of materials are taken into account, the results here are at least as good as those in Great Britain.

No data concerning the operations of the council have been given out by that body, but in a general way it is known that of the materials approved by the state highway departments the council was also to supply about 85% of the bituminous materials, over half of the cement, about the same proportion of brick, about three-fourths of the crushed stone and about two-thirds of the gravel. Steel was practically beyond the reach of the council, for the other war committees required all of it for war purposes.

The reasons for declining to furnish materials approved by the state departments have been quite varied. In the Southeastern states the transportation situation has been so difficult that it was necessary, speaking generally, to restrict the quantities of materials brought into that section to a minimum, and to stop all freight movements not essential. The fuel shortage operated to restrict the output of cement and brick below the quantities which the producers were able and willing to supply, if permitted to do so. The threatened shortage in fuel oil made it necessary to exercise, over some grades of bituminous road materials, control which would otherwise have been unnecessary. Transportation difficulties existed in some of the Central states which interfered somewhat, in all probability, with the delivery of materials allocated by the council, although the Railroad Administration did all it could to furnish transportation, for road materials, granted by the council. That body has stated the reasons for its actions in individual cases without any attempt at concealment, but it could not lay down detailed rules governing the allocation of materials, because the conditions varied from time to time and from place to place. All it could do was to give every possible help to essential road projects approved by the state highway departments, at the time these applications were received.

The roads of the country have suffered from lack of maintenance, but that is a chronic condition in the United States. It is open to debate whether maintenance would have been done any better throughout the country, as a whole, if there had been no war conditions. The most serious result has been the ruin of many miles of roads by heavy military trucks, just as in Great Britain. Neither country has produced any effective measure of diminishing such destruction by control of speed and careless driving, and very little attention has been paid to overloading.

Selection of National Highways

In this country, as in Great Britain, the war has shown that some roads are a military necessity—which is synonymous with national necessity. It has shown that where railways are congested and good highways are available the latter are a decided help in moving freight, particularly fast freight. But it is apparent in both countries that the cost of building roads for heavy trucks operated at high speed is so great that no balance sheet of the cost of motor trucking which does not include an item for roadbed—just as the cost sheet of railway transportation includes such an item—is complete, and it may be so incomplete as to be misleading. The experience in this country indicates that one of the most difficult things to define is a "road of national importance," and while there is an evident tendency in both countries toward national highways, the war has done little to help along the determination of those roads whose construction and maintenance are so widely useful that they are plainly of national rather than state importance. The war over there and its influence over here have shown that railways, waterways and highways form a complete transportation system that can only be successfully studied in a broad way, free from economic errors, when studied collectively, before its parts are taken for detailed investigation.

Earthquake Wave-Action in Guatemala

WAVE action of the earthquakes in Guatemala last winter is shown effectively by the effects on an old masonary aqueduct near Guatemala City, according to Lee F. Whitbeck, chief engineer of the International Railways of Central America, who has sent the accompanying view.

He states that at a high arch, illustrated in *Engineering News-Record* of Oct. 3, p. 624, the fallen keystone-shaped block of heavy masonry lies directly under its

WAVE ACTION OF EARTHQUAKE RUPTURES COVERED AQUEDUCT AT REGULAR INTERVALS

former position in the arch, indicating that the wave distance coincided very nearly with the distance between the pillars. Under the wave action the spandrel walls evidently puled apart, allowing the central block of masonry to fall, and then closed. This occurred in a succession of arch spans. The wave distance is clearly marked in the accompanying view of the covered aqueduct, where this action caused the arched roof to "pop out" at regular intervals.

How Soldiers Were Quartered and Fed in the Spruce Production Camps

ALTHOUGH there were many phases of the soldier's life in the Northwest woods, under the direction of the Spruce Production Division, which were unlike that at military encampments, yet the camp sanitary regulations were on a strictly military basis and were rigidly enforced. A great contrast to the usual woods camp was presented by the appearance of those camps in which soldier labor was quartered. Typical of these was Camp I-H at Raymond, Wash., the layout of which is shown in the accompanying drawing. The plan shown was the standard arrangement for camps of 100 men. While the men were in fact "under canvas," yet all the tents had wooden floors and wooden wainscoting 3 ft. high, with a wood frame structure over which the tent was stretched. A striking feature of the camp was the scrupulously clean condition of all quarters inside and out, and the strict regulations concerning all sanitary measures. In the mess hall the boards in the table tops and bench seats were loose and were removed and scrubbed daily. Hot and cold water was always available in the bath tent, a feature of the camp that was very popular. The quarters were kept clean and in order by the men themselves. The beds were made, floors swept, clothes hung up, Army shoes shined, blankets aired twice per week, and the sides of tents raised or furled when the weather permitted. The sleeping quarters were inspected daily by both the commander and the doctor of the company.

The regulations of the Food Administration were strictly observed, and meals were served by the contractor on a cost-plus-10% basis. The quality seemed to be very satisfactory to the men. The quantity of foodstuffs and the actual costs of meals served in several of the camps, during August, 1918, are given in the following table:

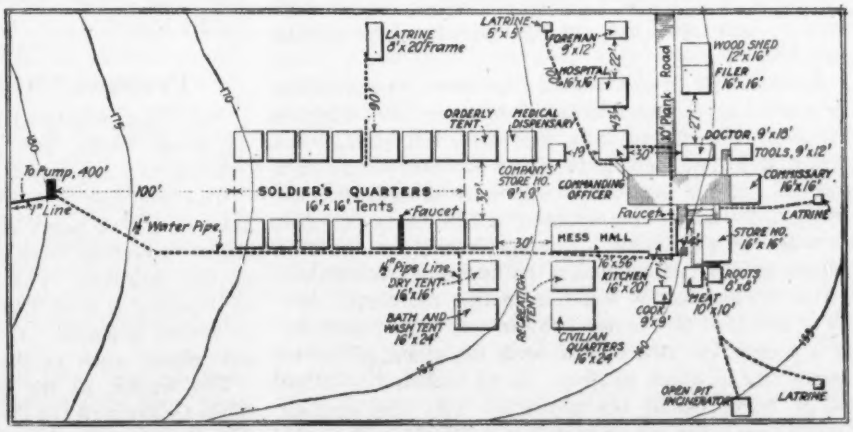
AMOUNT AND COST OF FOOD SERVED AT THE ARMY LABOR CAMPS OF THE SPRUCE PRODUCTION DIVISION

Camp	Sugar Per 90 Meals (Standard 6 Lb.), Lb.	White Flour Per 90 Meals (Standard 23 Lb.), Lb.	Total Food per Meal (Standard 2.2 Lb.), Lb.	Number of Meals	Cost per Meal
I-A	4.00	7.03	1.404	14,526	$0.24
I-CH	10.76	14.34	2.984	7,690	.485
I-D	6.18	11.88	2.191	8,514	.374
I-E	6.01	11.33	2.047	3,549	.3374
I-F	3.05	14.00	2.086	5,994	.413
I-G	4.03	15.00	1.820	9,642	.339
Averages,	5.67	12.26	2.088	49,915(total)	$0.3647

These figures were supplied by G. W. Gauntlett, district supervisor for the Warren Spruce Co., at Raymond, Wash., in which district these camps were located.

Wayne County Highway System To Be Extended

A further development in the plant of the Wayne County, Michigan, highway system calls for encircling of the county with three belt lines, according to the annual report of the county road commissioners, recently issued. Ten main roads now radiate from the City of Detroit, being completed to the county lines and connected up to most of the villages and cities. The outer belt will be finished this fall, and a start has been made on both the middle and inner belts. These belts will enable traffic to get out of Detroit on any main road and return by any other main road, as desired.



TYPICAL LAYOUT FOR SOLDIER-LABOR CAMP FOR 100 MEN

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

How Raise Status and Pay of Engineers?

Sir—In engineering magazines there is much discussion as to the status and pay of engineers. Not very long ago, while reading a scholarly article along these lines by an engineer of prominence, the writer could not dismiss from his thoughts an experience with the organization of which this same engineer was the chief engineer, in which his indisputable rights received no consideration. This article strengthened the opinion—which had gradually grown to be a conviction—that the average engineer working for a salary has the employer-engineer and those in the higher positions to thank for most of his blessings in the shape of remuneration and resultant standing in the community in which he lives.

The employer-engineer fixes the salary, and to a certain extent controls living conditions. No complaint has ever been heard that he fixes the salary too high, or makes conditions too livable. His main idea seems to be to make low cost records. On large projects no other item contributes so little to the total cost as engineering. Still, in these times, when skilled and unskilled labor is getting two or three times its normal pay, we find some lines of engineering working on practically the same basis as in pre-war times.

Evidently, there will be no relief from this state of affairs until we have an association to look after our own interests. Whether it will be necessary to form a new one or reshape an existing one is the question. Such an association could adopt a minimum scale of salaries for all grades; that is, in civil engineering for rodmen, instrument men, assistant engineers, etc., in the various branches; for city engineers in cities of various sizes, etc., and similarly in other lines of engineering. The engineer or employer who violated this scale could be blacklisted. In a short time the rank and file of engineers, seeing the advantages of such an association, would come into the fold. This may smack too much of unionism to some engineers, but through such an association only, in my opinion, can results be obtained.

Some months ago, in a small city, the seven physicians by mutual agreement doubled all of their fees. Suppose the engineers of that city had done the same, what would have been the result? They probably would have starved, for the services of others from outside could undoubtedly have been obtained at the old rates. Not so with the physicians. Another would not think of coming in and cutting under the new scale established.

Did the physicians' standing in this community suffer? Not that the writer is aware of. The prosperity of a person has much to do with his standing in the community in which he lives. In all probability—other things being equal—the physician with the smallest practice in a big city has a better standing than the city engineer who, acting singly, probably could not get a penny's increase in salary.

These observations are made by an engineer who for twenty years has been of the opinion that hard, earnest work is the all-important thing, and that salary, conditions, etc., will take care of themselves. Twenty years' experience has made him "a sadder but wiser man," and has led him to the conclusion that only through an organization similar to the one suggested above can the rank and file of engineers get results.

SUBSCRIBER.

Sir—"Questioner," in your issue of Dec. 5, p. 1042, states that "following the signing of the armistice he lost a position paying $350 a month." On the same page there is also a letter from V. S. Lawrence on the wage question.

While perhaps but little consolation to these writers, an article in the Sunday papers entitled "Grindstone Jennie," by Christine McKenzie, is *apropos*. The gist of the article is this: Mrs. Hanch is a pretty widow, 24 years old and she has one child. A few months ago she was earning $2 a day as checker in the Submarine Boat Corporation shipyard's (Newark Bay) commissary. She was transferred to a machine shop and her pay jumped from $2 to $8 a day. It took her about two hours to master her new job, earning $48 per week.

This is in striking contrast to $35 a month received by a leveler on a line now owned by the Baltimore & Ohio R.R., with $15 added for board; and $65 a month paid the resident engineers on a line now controlled by the New York Central R.R. Many other instances can be given which would place the engineering profession in very unfavorable light.

I have read Dr. Charles R. Mann's report very carefully, and, in the vernacular of the day, "What's the idea?"—spending years in a college to imbibe knowledge which will yield but a small remuneration, when two hours' practice in a shipyard will bring in $8 per day?

I have been a member of the American Society of Civil Engineers for 30 years, and my membership has never been a financial advantage to me. As you plainly say on page 1057 of your issue of Dec. 12, the main object of engineering societies is "the reading of voluminous papers." I recall one of 350 or more pages that could be compressed into 35. E. N. GINEER.

"No Place."

Proposes National System of Trails

Sir—The pedestrian has been driven from our roads by motor traffic, but, as he is still on earth, he is entitled to some consideration.

The tendency in locating and relocating roads is to take care of a heavy commercial traffic, so that roads begin to assume more and more the utilitarian aspect of the railroads. The problem, even in scenic areas, of locating a road that combines utility and scenery is almost hopeless. It has, however, been done in a few places, such as the Columbia River Highway.

The writer, as the locating engineer for the state highway through the Snoqualmie Pass in 1913 (Cascade Mountains, State of Washington), gave this phase of

the locating problem special study, but with only moderate success; the prettiest places were not touched by the road. Construction of trails through the country and mountains will accomplish this end. These trails should follow certain uniform lines. The right-of-way should be 30 ft. wide. In the matter of grade and curvature, there should be anything up to 10% grades, and curves with a maximum radius of 60 feet.

In the United States, as in all countries, the wealthy have acquired the best places both in the mountains and along the coast, so that an American cannot see his own country except by permission of private property owners. Now, although a man can rightly object to having his estate cut up by a road, he could not make the same objection to the construction of a trail. On the trails, no motor-propelled vehicle or motor cycle should be allowed, and no livestock should be driven over it. The surfaced portion of the trail should be 10 ft. wide—this will enable troops to march in column of squads. These trails would have a great value in the training and maneuvering of infantry, and would be used by the Boy Scouts on their hikes. Trails would run through all the cities and towns.

Every state highway department should have a trail department, so that the work of location, construction and maintenance could be kept separate from that of the roads. It is probable that county engineers would separate their work into road and trail work. By designating a project, for instance as the "Sunset Trail," it would be easy to distinguish between it and the "Sunset Highway," although in naming trails duplication of names should be avoided.

The question of bridges would call for a large variety of treatment. The conditions, as between the mountains and the seashore, would be too variable to permit of the laying down of hard and fast rules. It would add to the military value of a trail situated in a strategic area if all structures were designed to carry a 10-ton road roller.

"See America First" is a good slogan for all Americans, but America cannot be seen until we have built at least 100,000 miles of trails.

Renton, Wash. FRANK W. HARRIS,
Captain, Civil Engineer, United States Army.

Concrete-Base Track For Bridges

Sir—Your editorial of Dec. 12 on concrete-base track and the illustrated article on a 2000-ft. stretch of permanent way of this character on the Northern Pacific R.R., as well as the article on waterproofed floors for railroad crossings over streets, by H. T. Welty, recall testimony given by me in 1917 on behalf of the City of Elizabeth before the Board of Public Utility Commissioners of New Jersey, advocating the use of such concrete-base track for bridges, referring to the low maintenance costs in the subways and elsewhere for such permanent way, and giving also some new designs for concrete bridge floors and other trough sections for ballasted floors.

I introduced here four types of thin floor construction, keeping to about 3 ft. thickness from the underclearance line to the top of the rail (my records are in New York), designed in connection with the problems of eliminating grade crossings on the Central R.R. of New Jersey, where headroom over city streets was very limited, and in new alignment and changes for six tracks of the Pennsylvania Railroad through Elizabeth. The crossing of 12 tracks at two levels over Broad St. made a very interesting problem, one street approach being on sharp curve and at a grade of over 7%, dipping under the intersection of the two railroads to a sinkhole which could not be drained by gravity. The upper railroad was at its summit, with falling grades in both directions.

In making these designs to meet such requirements for thin floors, I began with the old Thompson trough floor which my chief installed on the Park Avenue viaduct in the early nineties, when I was assistant engineer on this work, and followed other practice of record and in evidence within my experience about New York. Mr. Welty has the benefit of all the experience in better designs used on the New York Central R.R. since then, and gives valuable information concerning his several types which may be adapted to the various requirements of the railroad engineer.

In the testimony we brought out at the grade-crossing elimination proceedings to which reference has been made, it was shown that waterproofing materials generally used were not flexible or sufficiently elastic, especially, as Mr. Welty says, at the junction with main girders and attachments of least deflection, and a good type of waterproof thin floor was not in evidence.

Philadelphia, Penn. R. W. CREUZBAUR,
Emergency Fleet Corporation.

Discussion Has Failed to Reach Bottom of Highway-Truck Problem

Sir—In the many discussions of the "motor truck vs. highway" problem that have appeared in print during the past few months, there has been, I believe, an almost unanimous failure to get far enough back into the economics of the proposition. The question that is now vexing highway engineers the country over is, like all other questions, based on certain propositions that have been either firmly established or long recognized as axioms. Starting from these basic propositions, one should be able, by logical steps, to answer beyond the shadow of a doubt two very important questions: First, "Has the motor truck an economic right to exist?" and, second, "Is there a definite relation between the capacity of the truck and the cost of the road and has this relation, in common with other relations, one point that is economically to be preferred?"

Considerable compilation and collaboration will be necessary to answer finally the questions stated above, but the logic that is involved in the answering may be outlined. The questions are of such broad import that there is neither justice nor wisdom in putting the whole thing up to the highway engineer. They are questions for the whole engineering profession to solve, and that solution must be found soon. But let us state the facts that have been overlooked, apparently, in the discussions to date.

As an opening statement on which all can agree, we can reënunciate the old statement—long established but often disregarded through oversight or design—that

"it is the ultimate consumer that pays the bill." This expression has been bandied about until it has become almost if not quite hackneyed, and yet it is deliberately ignored in even the most elaborate estimates of the cost of motor transportation. In the most reliable of the estimates—those based on actual performance—we shall find entering into the ton-mile costs all items relating to the truck itself—interest, depreciation, repairs, taxes, insurance and operation. In how many of them shall we find the fact recognized that money spent on roads for interest, depreciation or repairs should also enter into the estimate? What would happen to the privately owned railroad if it forgot, when fixing its freight rate, to include the cost of building and maintaining its roadbed, bridges and tracks?

When a merchant receives a consignment of goods by freight, he pays for such transportation service a definite amount—an amount which includes the whole cost of bringing the goods to him. This amount he adds to his other costs, in fixing the price to be paid him by the consumer for the goods. If the goods are transported by motor truck instead of by rail, the cost of part of the transportation service—building and maintaining the road, the track on which the truck operates—is not included in the price paid by the consumer for the goods. This cost is paid, however, by the consumer in the shape of a state or Federal tax for highway purposes. Because of our more or less invisible system of taxation, it is impossible to attack the problem from this end—that is, we cannot determine the actual cost to the consumer of any article in which such an item as a road tax enters. The true cost of transporting goods by trucks can be established, however, but before proceeding to outline the procedure let us point out once more that "the consumer pays the bill" either as a higher rate to the railroad or as a tax to the state.

In order to establish the true transportation charge on material carried by trucks, we must include part of the cost of building and maintaining the road. Here begins the argument between the highway builder and the truck manufacturer. What part of this cost shall be included? Opinions, more or less biased, may be uncovered, varying all the way from all to none. A position at either extreme of the discussion is untenable.

Disregarding the truck, roads are still of prime importance and still cost money. It is comparatively a simple matter to determine what a road will cost, both for building and for maintaining, to meet successfully any class or concentration of traffic. It is possible to build a road over which we could transport the Rockies, a mountain at a time, and such a road would be not a question of skill but merely of money. We can therefore determine the difference in cost of building and maintaining a road designed for any class of traffic, and a road designed for any other class of traffic. The calculations may be complicated, but they can be made. With these differences in cost, we are in a position to determine the true transportation charge over a road per ton-mile by trucks of various sizes.

As long as this ton-mile cost is lower than the corresponding freight rate, the truck is an economic factor in life and has a right to consideration, and the truck that would make this figure a minimum is the truck to use, whether its capacity be a hundredweight or a hundred tons. With highways designed for such a truck, it remains for legislation to provide for the proper use of the highways.

It may be objected that the solution is easy to point out but hard to find. That is true, but it is not a problem for one man or for one group of men to solve. We all know the story of the bird that, having found a hole in the roof of a deserted house, tried to fill the house with acorns—how he worked and worked and finally gave it up with the idea that it could not be done. It could have been done, nevertheless, but not by one poor little bird. Just so this proposition calls for the united experience of truck makers and users the country over, even involving the value of different designs in truck construction. It calls for the clearest thought of engineers and financiers and, since it touches the pocket book of every person that pays taxes—and who of us does not?—it is a legitimate subject for Governmental consideration.

W. EARL WELLER,
Binghamton, N. Y. City Engineer.

Lehigh Valley Dredging Chart Used As Standard for Records

Sir—Referring to the graphic dredging chart shown in your issue of Dec. 12, p. 1070, furnished by G. T. Hand, chief engineer of the Lehigh Valley R.R.: I was allowed to make a few suggestions in this scheme for showing at a glance performances and hold-backs in the work of this suction dredge, operating for the Emergency Fleet Corporation.

Last spring the Fleet Corporation was seriously in need of a third dredge to clean up the turning basin at the Newark Bay shipyard. Partly for patriotic reasons an unnamed 20-in. hydraulic dredge, which we called the "Lehigh," was put to work for the Fleet Corporation on a low flat rental basis. It gave, as partly shown in this chart, an output as high as 970 cu.ft. per hour on a 3200-ft. discharge. This was generally light material, silt, including some shell and hard material.

The work of this dredge was frequently interrupted by the breaking of the line across the Port Newark channel, where we had made an arrangement with the quartermaster's department for quick opening, but in spite of this device the percentage of channel openings ran from 20% to 28% of the total time, increasing costs; notwithstanding this, the clean-up was entirely satisfactory as to cost.

On getting this diagram from Mr. Hand last spring I took the liberty of using it as standard for dredging records in the several shipyards coming under my control.

R. W. CREUZBAUR,
Philadelphia, Penn. Emergency Fleet Corporation.

Air Currents or Lorelei?

Sir—A queer sort of phenomenon has been occurring at Huntington Lake, the reservoir for the power houses of the Southern California Edison Co., at Big Creek, Cal. This takes the form of a shrill sound which travels, quite regularly, from one end of the lake to the other, very rapidly, and at an altitude of about 200 ft., apparently, above the surface of the water.

Huntington Lake is in the heart of the San Joaquin high Sierras, about 75 miles northeast of Fresno. The lake is about 4½ miles long and one-half to three-quarters of a mile wide, and extends northeast and southwest. The water in the lake is impounded by three large arched concrete dams, the tops of which are at El. 6950 ft. above sea level. These dams were raised from El. 6915 during the summer of 1917.

The sound in question was never heard before the spring and summer of the past year, 1918, and it is wondered whether or not the raising of the dams would so affect the action of air currents as to produce a noise which resembles the whir of the propeller of an airplane. The sound occurred regularly during the spring and summer months at 10 a.m. daily, starting in at the south end and traveling to the other end and back in 10 sec. Since the colder weather began in October the visitations have become irregular and less frequent, although they still occur at 10 a.m.

There is no construction work in progress that would produce an echo, and the only explanation advanced so far is that conflicting air currents may produce the sound. Some of the readers of *Engineering News-Record* may be able to corroborate this or offer another explanation.

D. H. REDINGER.

Big Creek, Cal.

Driven Pile Point Comes Out of Ground

Sir—In driving a wood pile at Pearl Harbor, Hawaii, some time ago, the shaft took a most curious path. As shown in the accompanying view, the point came up vertically through the ground some distance away from where it was driven. At the time the pile was being driven it was noticed that it was not driving straight, but driving was continued, with the result shown.

PILE 52 FEET LONG COMES UP OUT OF GROUND 18 FEET AWAY

The pile was 52 ft. long, of green douglas fir, and it was driven in a hydraulic back-fill of coral, overlying a rock excavation. The distance from the center of the butt, projecting 6 ft. above the ground, to the center of the point, projecting 4 feet, was 18 feet.

JAMES T. RESIDE.

Washington, D. C.

A Gift and an Appreciation

Sir—One of the most insistent demands to be met by a working engineering library is that for bound volumes of technical periodicals. It has been found that in the library of the Bureau of Yards and Docks the call for previous issues of *Engineering News* and *Engineering Record* is especially urgent. Up to a recent date, the bureau's file was far from complete, and some difficulty was being experienced in obtaining one or two volumes of comparatively late issue.

Henry B. Seaman, who has been connected with the Navy Shipyard Plants section of the bureau during the war period, happened to learn of this situation. Mr. Seaman, who was formerly chief engineer of the New York Public Service Commission, First District, bridge engineer for the Erie R.R., etc., has been a subscriber to the *News* and *Record* during a long professional career and up to a very recent date had kept an unbroken series of the bound volumes on his shelves. It was therefore with every indication of deep chagrin that he informed the writer that, owing to the hazards of moving from place to place, he had found it necessary to consign his entire collection only a week previously to a second-hand dealer in Brooklyn. The writer's regret, as may be imagined, became acute as the tale progressed. Mr. Seaman, however, was not disposed to let the matter rest. He held that the books ought to give the greatest service to the greatest number, regardless of his pecuniary interests in the transaction.

He accordingly got in touch with his dealer, found that the volumes had not been uncrated, and directed that the whole shipment, consisting of three heavy cases, be forwarded to this bureau at once by express, all expenses, save actual rail charges, to be met by him personally. In due time the consignment was delivered to this library, all volumes in good condition, complete with indexes, and excellently bound. Numbers were found to supply the recent deficiencies, and the previous volumes were "tied on" to the bureau's series—so that today, owing principally to Mr. Seaman's generosity, the Bureau of Yards and Docks possesses an unbroken file of *Enginering News* from 1887 to date, and of *Engineering Record* from 1890 to date—a collection practically invaluable for the bureau's purposes.

Over the gentleman's protest, this letter is being written as evidence of the unselfish public spirit and genuine human coöperation which seem to form a salient part of the first-class engineering character.

T. J. MOSLEY,

Librarian, Bureau of Yards and Docks, Navy Department.

Washington, D. C.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Contentious Contractors Shunned by Engineers

AN OLD contractor who was gossiping away an idle hour with the editor remarked: "One accomplishment which I may claim, and which few contractors can claim, is that in 30 years' contracting I have never had a lawsuit. Sometimes I have lost money by refusing to go to law, but I have gained a more valuable asset, which is the reputation of not being quarrelsome. That reputation has helped me to secure many contracts." Submission is a practice not free from risk. Occasionally, at least, the reputation of being able and willing to hit back is the best guarantee of peace. Nevertheless, it is true that the engineer having contracts to award shuns as one shuns pestilence a contentious contractor. That contractor may have the reputation of doing work quickly and well, of working to specifications in every detail, but, if he is known to be contentious, he is passed by for a contractor who is perhaps less capable but is certainly more amiable. A contractor's appeals to the law courts should be rare, and only when all other resorts have failed. A reputation among engineers of being "easy to work with" is an asset which a contractor should not lightly risk.

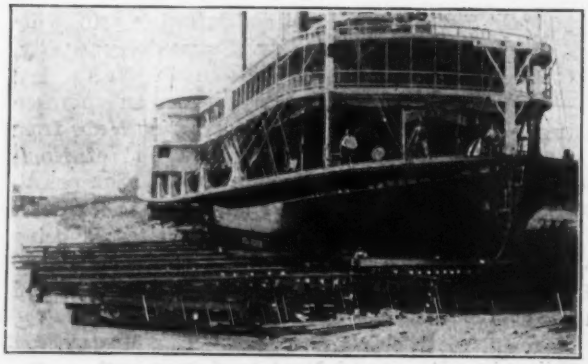
C. S. H.

Stranded River Boat Moved and Relaunched on Rollers

BY EMIL DAUENHAUER
Pittsburgh, Penn.

STRANDED by high water 250 ft. from and 30 ft. above the river edge, a 1000-ton steamboat was moved by jacks and rollers and side-launched without injury to any part, and a few days after the launching the boat resumed her regular schedule. Ordinary house-moving procedures were followed, and the operations, begun Aug. 13, were completed Oct. 7, 1918.

As shown by the view, the vessel was a typical steel-hull stern-wheel river steamer. The steel hull had a beam of 40 ft., but 16-ft. guards in the sides increased the overall width to 72 ft. The length was 248 ft., the draft at the stern 3½ ft., and the weight approximately 1000 tons. As stranded, the boat lay parallel to the river.



STRANDED RIVER BOAT MOVED TO RIVER EDGE PREPARATORY TO RELAUNCHING

Using 200 jackscrews, the boat was raised sufficiently to place it on runways consisting of 11 lines of 6 x 8-in. oak timbers laid to a grade of 1 on 12. Skids were placed under the hull, one over each line of runway timbers, and 8-in. wood rollers inserted between the skids and the runways; 225 rollers were used. When mounted, the boat was pulled to the river edge by six sets of block and tackle reaved three and three. At the river edge it was necessary to grade down the bank and carry the runways down to an elevation about 4 ft. above water level. Jackscrews eased the vessel down the steeper grade. From the ends of the runways 11 lines of launching ways were extended down into the water to a depth greater than the draft of the vessel. These launching ways were 13 x 15-in. timbers, thoroughly blocked and braced. The grade was 1¼ on 12. The boat was slid down the launching ways on skids and rollers.

The contractors for the moving and launching were the John Eichleay, Jr., Co., Pittsburgh, Penn. The writer was in charge of the work. The boat was the "Kate Adams," owned by the Memphis, Helena & Rosedale Packet Company.

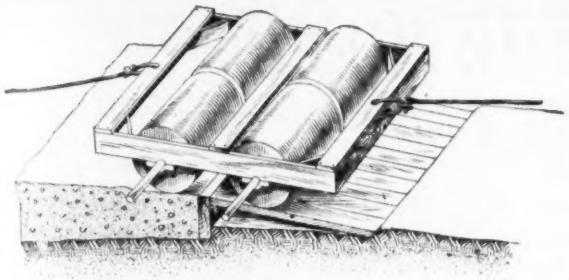
Double Roller and Long Board Float Give Superior Road Finish

BY SAMUEL P. BAIRD
Columbus, Ohio

EXCEPTIONALLY good finish on a concrete road built at Camp Sherman, Ohio, was secured by using a double roller and long board float. The roller and the float were built on the job.

At Camp Sherman the warehouse street has two 30-ft. pavements separated by a 10-ft. utility space for pipes and poles. The pavements have no crown, but for proper drainage received transverse grades of 6 in. in 70 ft. to 17 in. in 70 ft. The slabs were built in lengths of a day's run, the longest being about 135 ft. The side forms were 2 x 6 in. x 16-ft. Southern pine planks. As the forms were left in place to protect the edge of the slab, their construction was unusual. To insure exact elevation, the side planks were supported on 2 x 4 x 12-in. blocks set 3 ft. apart and tamped to solid bearing in the ground. Thin wedges on the blocks adjusted the plank to exact elevation, and stakes held it upright. To hold the planks close to the slab edge when the stakes were removed, ¾-in. wire ties 3 ft. long were inserted 3 ft. apart along the edge of the slab.

After the concrete had been struck off with an extra heavy strikeboard it was compacted by the double roller shown by the drawing. Four 28 x 18-in. rollers were made of No. 18-gage galvanized iron shaped in a bend-



DOUBLE ROLLER FINISHES CONCRETE PAVEMENT

ing roll. Each roller had a 1¾-in. solid head in each end, made of two ⅞-in. boards that were placed with the grain crossed.

There were also intermediate heads ⅞ in. thick. These heads were sawed out on a band-saw. The center hole was a loose fit on a 1-in. pipe. Between the rolls and between the rolls and the frame were placed ⅞-in. wood washers. The pipe axles were rigid in the frame and extended beyond the frame, for use as convenient handles. All the frame material was ⅞ in. x 4 in. cypress. When completed the roller weighed 105 pounds.

The location of this work was so restricted by warehouse platforms on one side and a very busy street on the other, that the use of a roller with a handle was out of the question; also, a single roller hauled by ropes did not give satisfaction, so the double roller was designed.

The split feature was the result of an afterthought; we could not find a bending roll to handle anything wider than 28 in., nor could we get the material, No. 18-gage, any wider than the standard sheets.

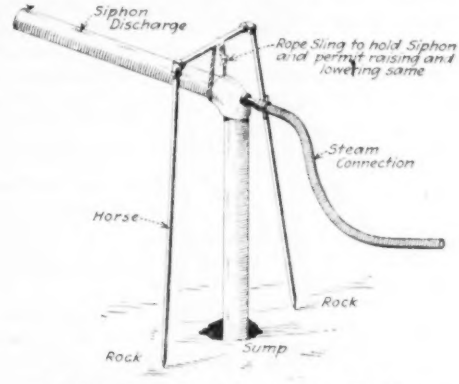
To get best results, there should be placed at each side of the road temporary strips outside the side forms, as shown by the sketch, so that the front roller can be readily pulled over the side forms. In this way any water which is ahead of the second roller can be forced over the forms.

Removal of the water is one of the objects of rolling concrete. Another good result is the crowding down of the coarse aggregate slightly below the surface, thus permitting the ready use of a float 2 ft. longer than the road is wide, and made of some light wood from ½ to ¾ in. thick and 8 to 10 in. wide. The results are more satisfactory than those given by a belt. At Camp Sherman the float used was a cypress board ½ x 6 in. and 32 ft. long, composed of two 16-ft. pieces spliced on top. The split-roller idea is of no practical use in my opinion, as the roller—whether pulled by ropes, as in the case in question, or by a handle—is not easily controlled as to direction of movement, and any rolling close to the expansion joints tends to get them more or less out of line.

Simple Horse To Support Steam Siphon

By G. W. McAlpin
Point Pleasant, W. Va.

FOR holding steam siphons on rock foundations the horse shown in the accompanying sketch has been successfully used. It is made of two pieces of 1½-in. pipe pointed at the bottom to hold firmly on the rock, and

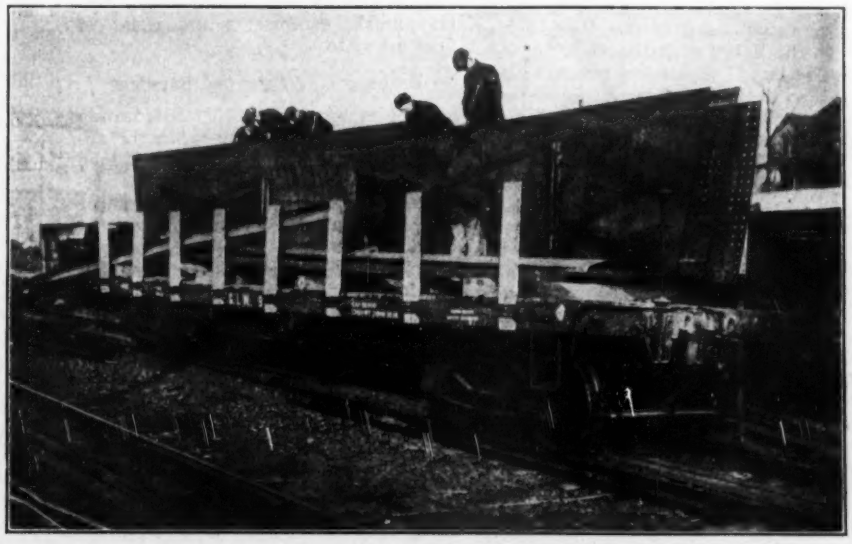


SIMPLE SUPPORT FOR STEAM SIPHON

connected at the top by elbows and an 8-in. nipple. The siphon is suspended between the legs of the horse by a rope passing over the nipple. This permits the raising or the lowering of the siphon, as desired. By resting the discharge pipe of the siphon on a discharge chute, or other convenient rest, balance is obtained.

Shipyard Has Cars With Plate Racks

TO FACILITATE loading and to reduce dangerous overloading, the Groton Iron Works, in the shipyard at Groton, Conn., introduced racks on the yard cars. One such car is shown in the view. This car has plate racks in the middle and shape racks on the side. A greater weight can be carried in this way, and there is a great saving by loading without respect to the piece wanted first and by making it possible to pick out the desired piece when the car is at its destination.



YARD CAR IN SHIPYARD HAS RACKS FOR PLATES AND FOR SHAPES

NEWS OF THE WEEK

New York, January 9, 1919

City Drops 300 Engineers on Half Day's Notice

New York Rapid-Transit Work Crippled By Cut in Appropriation—Many Contracts Will Be Affected

A New Year's surprise came to over 300 engineers of the Public Service Commission, New York City, in the shape of abrupt discharge from their positions. The Board of Estimate of the city resolved upon this action at a meeting held Dec. 30, and advised the Public Service Commission of the action on the following day. As the matter involved was the administrative appropriation for the first quarter of 1919, the engineers affected were given notice of the termination of their employment on the evening of Dec. 31.

Application made by the commission for the sum of $559,000 for administrative expenses during the first quarter was submitted a month ago, but was not acted upon until Dec. 30. The Board of Estimate cut the amount asked for to $291,000, and required that this amount be expended in accordance with a schedule of positions prescribed by it. This list, as compared with the existing organization of the rapid-transit work, represented a reduction of 376 men (out of 1004), of whom 334 are engineers (out of 812).

Board of Estimate of City Has Final Authority

Prior to the present year, it was possible for the Public Service Commission to appeal to the Supreme Court in urgent cases, but under a new law of 1918 it is considered that final authority as to all appropriations and other administrative matters involving other departments of the city is lodged with the Board of Estimate. The Public Service Commission has therefore applied to the board for a supplemental appropriation to restore its staff to proper number.

Sverre Dahm, deputy chief engineer, and George S. Rice, division engineer, are two of the men whose positions were abolished by the appropriation schedule. All designing engineers but one were discharged, and the designing force cut from about 130 to 41—this in spite of the fact that new contracts are in course of preparation for letting during the current year, among them those for the Nassau Street line, the extension of the Steinway tunnel, and new elevated extensions and yards. The work in hand was sufficient to tax the resources of the designing division as it was organized, and cannot be accomplished in the necessary time by the reduced force. In the field, corresponding conditions prevail. In a typical instance, the division engineer and the assistant division engineer are dropped the senior assistant is retained, the section engineer and one inspector and four junior engineers are dropped; this section has lost seven men, out of a staff of eleven. It happens to be one of the sections on which work was being rushed in order to complete the line of which it is a closing link, so as to permit starting of operation of traffic. A number of other sections show similar figures, and in general it is a typical instance of how the situation affects the field work of the commission.

Supervision of field construction is one of the important daily functions of the engineering organization of the Public Service Commission, especially as, under the contract, the commission must furnish all engineering data to the contractors, including lines and grades for all construction. The contractor is dependent wholly on the engineer for field information on the location and the character of the work, for approval of finished work, and for estimates for payment. In work of particular difficulty, as the river tunnels, the engineering service is continuous, and the proper progress of the work essentially dependent upon it. As it will be impossible to perform these varied functions with the depleted staff, the acting chief engineer of the commission, Robert Ridgway, is temporarily making such adjustments and exchanges of men as will permit operations to be carried on in normal manner at the most vital points. The commission's contracts at present include about 20 active sections of rapid-transit lines, exclusive of many contracts for track construction, station finish, equipment, and cases of final estimate.

Engineers Volunteer Services

In order to maintain the organization and allow work to continue, in the anticipation that better counsel will soon prevail and the organization be restored to working condition, a number of the discharged engineers voluntarily continued in their regular duties, giving notice to the commission that this continuance in service is at their own risk, subject to future provision for it by the Board of Estimate, and that the commission is not liable to any claim against it for these voluntary services.

The present crippling of the commission's organization follows a long period of sharp political controversy between members of the commission and officials of the city Government (the commission is a state body, though dependent upon the city authorities for its appropriations and for ap-

(Concluded on page 114)

Commerce Commission For Return of Railroads

Sentiment Favors Return Within 21-Month Period Rather Than Five-Year Control Plan

At the Senate Interstate Commerce Committee's hearing on proposed railroad legislation, Commissioner Edgar E. Clark presented the first alternative yet proposed to Director General McAdoo's plan for a five-year extension of Government control. The Interstate Commerce Commission considers that the 21-month period intervening between the signing of the peace treaty and the return to private ownership affords sufficient opportunity for readjustment before the roads are turned back by the Government. Commissioner Clark said:

"Considering and weighing as best we can all of the arguments for and against the different plans, we are led to the conviction that with the adoption of appropriate provisions and safeguards for regulation under private ownership it would not be wise or best at this time to assume Government ownership or operation of the railways of the country."

He also stated that it seemed obvious that no plan of private ownership should be considered unless it be under broadened, extended and amplified Government regulation. He said that comparatively few contracts for compensation had been perfected between the transportation companies and the Government. Return to private ownership and operation should, therefore, not be understood as meaning precipitous return. A reasonable period of readjustment or preparation should be afforded, and reasonable notice given that upon a given date the properties would be restored to their owners.

Commissioner Woolley dissented from part of the report and gave a number of reasons why he favored the extension plan proposed by Mr. McAdoo, saying that the good accomplished far outweighed the shortcomings and was a promise of better things for the future, and that the proposal to return the railroads to private control had not yet been productive of any concrete plan which would carry the undertaking safely over the breakers obviously ahead.

The commission reiterated its recommendations, made last year, that the Presidential power to merge lines during war or peace should be continued, that railway construction should be limited to works of necessity, and that inland waterways should be developed and coördinated with the railways.

Says France Will Do Her Own Rebuilding

At the meeting of War Service Committee chairmen in New York City, Jan 3, W. H. Manss, until recently chairman of the War Service Executive Committee of the United States Chamber of Commerce, stated that investigations of which he had knowledge had disclosed the fact that France intended to do her own rebuilding. He told the maunfacturers' representatives present that they could not expect much French business in materials. He strongly urged the initiation of an extensive public works program, particularly in highways, emphasizing the point several times. Mr. Manss' words bear out the statements made by *Engineering News-Record* of Jan. 2, that American engineers and contractors—at present, at least—are not wanted in France.

Professional Division U. S. Employment Service Opens Office

The Professional Division of the United States Employment Service has opened a New York office at 16 East 42nd St. Its registrations of experienced professional men are increasing. University graduates in mechanical, electrical, and civil engineering, and in chemistry, and other technical men with several years of practical experience are now registered. The record of each man is carefully investigated before registration is permitted.

Employers seeking men of professional experience are asked to inform the division of the precise nature of the positions which they wish to fill. Only men who are well qualified for such positions are referred to employers.

Zionist Engineers Organize to Rebuild Palestine

The first annual conference of the Zionist Society of Engineers, which was organized at a National Zionist convention in Baltimore in June, 1917, was held Dec. 28-30 in New York City, for the purpose of instituting plans for undertaking engineering development in Palestine, in connection with the expected immigration.

The opening session of the meeting was addressed by Judge Julian Mack, president of the Zionist Organization of America, Jacob de Haas, secretary of the organization, and Dr. Benzion Mossinsohn, director of the Hebrew Secondary School, Jaffa, Palestine. Pledges made by the allied nations with respect to Palestine were reiterated. A resolution was adopted that the society immediately embark upon the preparation of plans and estimates for the agricultural and industrial projects which will be made necessary by the expected immigration. To carry out the resolution, studies of the national resources, topography, etc., of the Holy Land will be made, and a commission will be sent as soon as conditions warrant such a step.

Colonel Roosevelt's Part in Panama Canal and Reclamation Work

Tributes to the Former President by

GENERAL GOETHALS *and* Dr. NEWELL

FOLLOWING receipt of news of the death of Colonel Roosevelt, "Engineering News-Record" asked Maj.-Gen. George W. Goethals, former chief engineer of the Panama Canal, and Dr. F. H. Newell, former director of the United States Reclamation Service, for brief appreciations of the part the former President played in the great works with which they were connected. Their replies follow:

GENERAL GOETHALS—"American engineers especially should honor the memory of Theodore Roosevelt. It was due him that they were given the opportunity to show what American engineering science, skill and initiative could do in the greatest undertaking of peace in the history of the world—namely, the building of the Panama Canal.

"Theodore Roosevelt's name must be forever linked with the building of the canal. He boldly went in opposition to the Board of International Engineers which had decided upon what they believed to be the best type of canal, and whenever and wherever American engineers are gathered they should bear in mind that the confidence that Theodore Roosevelt had in them and in their work gave them the opportunity to serve in linking the nations and in making a highway among them which will forever serve the cause of Humanity and Justice."

DR. NEWELL—"Roosevelt's interest in the irrigation of the arid lands, the preservation and use of the national forests and allied engineering matters of broad national importance was not only deep-seated but effectively shown. That interest came primarily from an enthusiasm for out-of-door things, matured by his experience as a Western frontiersman and student of natural phenomena.

"As Governor of New York he came in contact with the forestry and water supply problems of his state. Almost his first action on arriving in Washington as President was to confer with the experts on these subjects in order to lay out with them his first message to Congress and to develop needed legislation. The resulting Reclamation Act, signed by him June 17, 1902, was made possible by his influence. He gave personal direction to many of the larger reclamation problems, cutting them free from entanglements of red tape and hampering precedents. His guiding principle was that the work, if necessary for the public benefit, should be carried out in spite of opposing precedents unless clearly prevented by existing law.

"We, as engineers, owe a debt of gratitude to Roosevelt not only because of his breadth of vision, embracing in its wide scope the public benefits conferred by engineers, but for his sympathetic attitude and effective co-operation in encouraging and securing methods that lead to economy and efficiency."

Engineers Honor Hoover

Almost coincident with the news that to Herbert C. Hoover has been given the huge responsibility of directing the distribution of food supplies to the neutral and enemy peoples of Europe comes the announcement that American engineers have recognized the great services rendered to humanity by their fellow engineer, by making him the first recipient of the Washington Award.

Two years ago, John W. Alvord of Chicago made a gift of $1000 to the Western Society of Engineers, to establish a prize which is to be given annual-

©Underwood & Underwood
HERBERT C. HOOVER

ly to some engineer, "on account of accomplishments which have preëminently promoted the happiness, comfort and well-being of humanity."

The award of this prize is made by a board of 17 engineers, of whom nine are chosen by the Western Society of Engineers and two by each of the four national societies. The award, therefore is representative of the American engineering profession at large.

As Mr. Alvord remarked in his letter giving the fund to establish the award, "almost all engineers serve the public, directly or indirectly, and it is one of the most important duties of engineering societies to point out to their membership and to the public such instances of engineering and administrative skill as seem to have unusual merit, in order that honor may be properly accorded where it is due."

The story of how Mr. Hoover organized the work of feeding the millions of people in Belgium and Northern France during the early years of the war, and how he organized food production and conservation in the United States, is fresh in the memory of everyone.

Now comes a task far surpassing in magnitude and difficulty either of the foregoing; and all agree that upon its accomplishment with some measure of success depends the chances of checking the flood of Bolshevism and anarchy now rolling westward.

Mr. Hoover has been in Europe for several weeks coöperating with the officials of the allied nations in an investigation of European food supplies and needs. On Jan. 3 it was announced at Paris that the allied governments had requested the United States to take a predominating part in the organization of relief measures in all enemy and neutral countries, and that President Wilson had named Mr. Hoover to be director general of the international commission which is to carry on this work. There are 250,000,000 persons with whose food necessities this commission will have to deal.

The story has been told, but will bear retelling, of Mr. Hoover's notable engineering career. That story is of a boy born on an Iowa farm, working his way through Leland Stanford University, being graduated with high honors in 1895 and tackling at once the hard work of mining engineering, first in New Mexico and California and then in West Australia. In his two years spent in the latter country, his rise was so rapid that in 1898 he was made chief engineer of the Chinese Government's Bureau of Mines. The Boxer rebellion of 1900 put an end to this work; and while it was going on he helped organize the defense of Tientsin. When the rebellion was over he found work for a few months in rebuilding Chinese railway and harbor works.

In 1901 he went to London, and as a partner in the firm of Bewick, Moreing & Co., mine operators, he became at once a prominent figure in the organization of mining industry, especially in the East Indies, China and Burmah. The engineering treatises which he somehow found time to write, "Economics of Mining," published in 1906, and "Principles of Mining," published in 1908, are standard textbooks for the profession.

It was characteristic of Hoover that he threw himself in 1914 heart and soul into the work of a hastily organized American committee which undertook the task of rescuing the 100,000 or so Americans who were caught unaware by the war's outbreak and were panic-stricken over the difficulties of getting home.

In the American colony in London, Hoover's great ability and public spirit were so well known that when the huge task of organizing relief for the Belgians was presented the late Ambassador Page was in no doubt where to turn to find a man equal to the need. From that time to the present Mr. Hoover has been devoting his time and ability to carrying on a work of public service without a precedent in the world's history, and without compensation other than the consciousness of duty that was well performed.

City Drops 300 Engineers

(Concluded from page 112)

proval of contracts and certain other acts). Governor Smith indicated his intention, even prior to taking office on Jan. 1, of reshaping the entire Public Service Commission, and in his message to the legislature recommended division of the functions of construction and regulation, each to be entrusted to a single-headed commission. Under these conditions the action of the Board of Estimate is regarded as merely an item in political warfare, having no regard to the efficiency or services of the engineering organization. No information has been obtainable to show whether the Board of Estimate considered in taking its action the delay and interruption to contract construction work and the probability that contract claims for delay will result therefrom.

War Service Council Approves National Highway Plan

Acting as an industrial advisory council to the War Service Executive Committee of the United States Chamber of Commerce, the chairmen of the War Service Committees at a meeting in New York Jan. 3 adopted a resolution advocating the construction of a national system of highways, the creation of a national highway commission, and the extension of the Federal-aid plan as applied to highways. The resolution was identical with that adopted by the Highway Congress in Chicago in December.

Resolutions favoring a national highway policy were adopted at several of the related-group sessions at the recent Atlantic City Reconstruction Conference, but did not get through the Clearance Committee. The latter body referred them for consideration to the War Service Committee chairmen acting as the Industrial Advisory Council.

Mechanical Engineers Take Over "Engineering Index"

The "Engineering Index," published for 25 years in *Engineering Magazine* and its successor, *Industrial Management*, and the standard index to engineering periodical literature, has been acquired by the American Society of Mechanical Engineers, and hereafter will be compiled and published by the society. The first issue of the index under its new management appears in the January number of the society's *Journal*. The index will be regularly issued in three forms: (1) As a part of the *Journal;* (2) as a separate monthly publication for libraries or individuals desiring to clip the items for indexing purposes; (3) as an annual volume in which all the items for the year are collected.

The "Engineering Index" originated with Professor J. B. Johnson of Washington University, St. Louis, Mo., in 1883, and for 12 years was prepared

under his direction and published by the Association of Engineering Societies. The following classifications give an idea of the scope of the "Engineering Index," as it will be carried in the *Journal:* Mechanical engineering, 31 subheads; electrical engineering, 11 subheads; civil engineering, nine subheads; mining engineering, 14 subheads; metallurgy, seven subheads; aëronautics, 19 subheads; marine engineering, four subheads; organization and management, 13 subheads; industrial technology; railroad engineering, 15 subheads; munitions and military engineering; general science, three subheads.

First Filter Plant Bids Received Since War's End Are Low

Bids received for a filter plant at Wyandotte, Mich., Dec. 30, one of the first municipal jobs of this kind to be advertised for since the armistice was signed, indicate that prices are apparently somewhat lower than those of last spring. For concrete masonry walls, beams and columns, the bids of the six firms represented ranged from $17 to $25. The low bid on filter boxes was $19 a yard. Cast-iron pipe prices ranged from $75 to $90, with specials ranging from $160 to $185. Flanged specials were listed from $185 to $250. The Pitt Construction Co. was the low bidder at $211,235. The figures given were received from R. Winthrop Pratt, civil and sanitary engineer, Cleveland, Ohio.

Angus Sinclair

The death of Angus Sinclair at the advanced age of 78 years removes a notable pioneer in American engineering journalism. It was 35 years ago that he left a job as roundhouse foreman on the Burlington, Cedar Rapids & Northern Ry. and came to New York City to be an assistant editor on the *American Machinist.* His experience previous to that time has been chiefly in the railway field. While holding the job named he managed to attend classes in chemistry at Iowa State University, and was made chemist for the railway company, a job at that time deemed of so little importance, however, that it was combined with the place of roundhouse foreman.

It was at this time that Mr. Sinclair began writing for the technical and railway journals. One of his early writings was a treatise on "Locomotive Running and Management" which has passed through 26 editions.

In 1883 he came to New York to take up work on the editorial staff of the *American Machinist.* A few years later the late John A. Hill also left a locomotive on a Western railway to go to the same journal, and the two men formed a friendship which resulted in a business partnership for the publication of a journal devoted to locomotive engineering. This made a rapid and spectacular success, which in a few years enabled the partners to purchase the *American Machinist,* on the staff of which they had started their work in journalism.

It was then decided to dissolve the partnership and Mr. Sinclair took the journal with whose field he was personally familiar.

He was a member of the American Railway Master Mechanics' Association for 46 years. He served as its secretary from 1887 to 1896, and was its treasurer from 1900 until his death. In 1908 Purdue University conferred on him the degree of Doctor of Engineering.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION; F. J. Angier, Mt. Royal Station, Baltimore, Md.; Jan. 28-29, St. Louis.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

NATIONAL RIVERS AND HARBORS CONGRESS; 824 Colorado Bldg., Washington, D. C.; Feb. 5-7, Washington, D. C.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The following state societies will hold their annual meetings as listed below:

Ohio Engineering Society, Columbus, Jan. 14-16.

Michigan Engineering Society, Flint, Jan. 21-23.

Indiana Engineering Society, Indianapolis, Jan. 23-25.

Illinois Society of Engineers, Bloomington, Jan. 29-30.

Minnesota Surveyors and Engineers' Society, St. Paul, Feb. 12-14.

Iowa Engineering Society, Muscatine, Feb. 19-20.

Engineering Society of Wisconsin, Madison, Feb. 21-22.

The Engineers' Club of Philadelphia will be addressed by Col. James B. Curtis, president of the American Manganese Bronze Co., on "The Legal Engineer," at the weekly luncheon Jan. 14.

The Duluth Engineers' Club, at a meeting Dec. 23 passed a resolution favoring immediate efforts toward the organization of the engineering profession in an effective form to render full public service and to obtain adequate recognition of the work of its members. A committee of five, to be appointed by the president, W. G. Swart, will communicate with other engineering organizations, in order to obtain coöperation and concerted action for calling a general engineering congress, in the name of and by the authority of all the cooperating societies. The Duluth committee will make a report of progress every two weeks. Another resolution relative to the street railways of Duluth was adopted; it suggested that a thorough engineering investigation be made and a plan prepared to provide additional trackage in the center of the city, to relieve present congestion.

The Boston Society of Civil Engineers has made the following nominations for office, through the nominating committee: For president, Leonard Metcalf; for vice-president, Robert Spurr Weston; for secretary, S. Everett Tinkham; for treasurer, Frank O. Whitney. The election will take place Mar. 19.

The Chicago Chapter of the American Association of Engineers was addressed Jan. 3 by Capt. Charles E. Merriam, on "Italy's Part in the War." Captain Merriam, who is a candidate for mayor, represented the Committee on Public Information in Italy.

The Brooklyn Engineers' Club will be addressed tonight by James C. Meem on "Metropolitan Subway Construction." Mr. Meem's paper will deal with the diversion of sewers during construction, the underpinning of buildings and overhead structures, provision for the care of surface structures, the excavation and disposal of material, and methods of tunneling.

The Rochester Engineering Society, Rochester, N. Y., was addressed Jan. 6 by Prof. Victor J. Chamber, University of Rochester, on "The Development of a Research; Synthetic Indigo." The regular monthly meeting of the society will be held tomorrow; C. E. Drayer, secretary of the American Association of Engineers, will read a paper on "Local and National Societies Coördinated."

The Technology Club of Syracuse, N. Y., will be addressed Jan. 13 by Secretary of Commerce William C. Redfield and Dr. S. W. Stratton, director of the United States Bureau of Standards. Secretary Redfield will speak on the various phases of the work of his department, with perticular reference to the Government's reconstruction plans for industry and the extension of foreign commerce. Dr. Stratton is expected to discuss important chemical discoveries not made public heretofore.

The Engineers' Subdivision of the Chicago Association of Commerce was addressed Dec. 30 by George Bayard Jones, who explained the recent report on the proposed rebuilding of various Federal buildings in Washington. He advanced arguments for the removal of the capital to a more central location. T. E. Tallmadge described a layout prepared for a model capital on Lake Michigan, north of Chicago. A committee to follow up the project was named.

PERSONAL NOTES

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

HENRY W. CLAUSEN, first assistant city engineer of Chicago, and formerly engineer of water-works construction, has resigned to enter the glove manufacturing business. Mr. Clausen's chief work in Chicago was the construction by force-account of the Wilson Ave. water-works tunnel, intake and Mayfair pumping station.

J. HAROLD RAPP and John J. Dunkel have become associated as the firm of Rapp & Dunkel, structural engineers, Fulton Building, Pittsburgh, Penn.

HOWARD B. KEASBEY has been appointed county engineer of Salem County, New Jersey.

H. STRINGFELLOW, district engineer, Southern Ry., with headquarters at Lexington, Ky., has been appointed district engineer at Charlotte, N. C., succeeding F. Furlow, appointed engineer of surveys, with headquarters in Washington, D. C., as noted elsewhere.

C. R. SEABROOK, who until last September was structural engineer, Chile Exploration Co., Chuquicamata, Chile, has become structural engineer for H. M. Lane Co., industrial engineers, Detroit. More recently he has been engaged in the Air Nitrates Division of the Ordnance Department.

H. Z. OSBORNE, JR., has resigned from the office of engineer of the Los Angeles street planning department to become chief engineer, board of public utilities. Mr. Osborne has been connected with the Los Angeles city engineer's office for 22 years. Last year he was elected president of the Engineers and Architects' Association of Southern California.

F. FURLOW, district engineer, Southern Ry., at Charlotte, N. C., has been appointed engineer of surveys, Southern Ry. Lines and Associated Railroads, with headquarters in Washington, D. C.

MAJ. H. W. LOCKETT, U. S. A., has obtained his discharge from the service and will become associated with Fred. S. James & Co., to take charge of engineering and inspection work. For the past year and a half Major Lockett has served as a building section chief in the Construction Division. Previously he was with the Chicago office of Fred S. James & Co. for 18 years.

IRA E. TAYLOR, previously county engineer, Pottawatomie County, Kansas, has been appointed assistant engineer, extension division, Kansas State Agricultural College, and will specialize in farm drainage.

FRANKLIN D. HOWELL, formerly chief engineer of the Board of Public Utilities, Los Angeles, Cal., has become general manager of the California Highway Transportation Company.

LIEUT. COL. EDWARD BARTOW, Sanitary Corps, U. S. A., was incorrectly mentioned in these columns Dec. 26 as Maj. Edward Bostow, due to a typographical error. He was in charge of water analysis laboratories for the American Expeditionary Forces, and has recently been promoted to the rank of lieutenant colonel. He was formerly director of the Illinois Water Survey.

KARL R. KENNISON, supervising plant engineer, Emergency Fleet Corporation, stationed at the recently completed concrete shipyard in Mobile, has been transferred to the office of the district plant engineer, Middle Atlantic District, Baltimore.

MAJ. CHARLES H. HIGGINS, Ordnance Department, U. S. A., has received his discharge from the service and returned to the firm of Delano & Aldrich and Charles H. Higgins, architects and engineers, New York City.

A. YAPPEN has been appointed assistant engineer in charge of bridge maintenance, inspection and operation, Chicago, Milwaukee & St. Paul Ry., succeeding C. N. Bainbridge, promoted to be engineer of design, as mentioned in *Engineering News-Record* of Dec. 12, p. 1102.

J. C. HILL has been appointed division engineer, St. Louis District, Missouri, Kansas & Texas Lines, with office at Sedalia, Mo., succeeding B. E. Wilbur, resigned.

CAPT. ARTHUR C. POOLE, Corps of Engineers, U. S. A., has returned from Camp A. A. Humphreys to his duties as city engineer of Rochester, N. Y.

L. S. HULBURD, senior assistant engineer, New York State Barge Canal, has been appointed division engineer of the western division of the canal, succeeding F. P. Williams, appointed special deputy state engineer, as mentioned in *Engineering News-Record* of Dec. 26, p. 1203.

W. L. WINTERS has withdrawn from the firm of Winters & Dove, civil and hydraulic engineers, Forth Smith, Ark., and is engaged in practice under his own name in the Merchants' National Bank Building, Fort Smith.

OBITUARY

DR. ROSSITER W. RAYMOND, mining engineer and author, previously editor of *Engineering and Mining Journal*, published by the McGraw-Hill Co., Inc., died at his home in Brooklyn, N. Y., Dec. 31, at the age of 78. He was graduated from the Polytechnic Institute of Brooklyn, and later studied at the University of Heidelberg, the Royal Polytechnic School, Munich, and the Saxon Mining Academy of Freiburg. He served in the Union Army from 1861 to 1864, after which he began practice as a mining engineer and metallurgist. Four years later he was appointed United States Commissioner of Mining Statistics, and in 1870 became lecturer on economic geology at Lafayette College. He was one of the United States commissioners to the Vienna World's Fair in 1873. He was appointed New York State commissioner of electrical subways for Brooklyn in 1885. For many years, beginning in 1866, Dr. Raymond was editor of the *American Journal of Mining*, which afterwards became the *Engineering and Mining Journal*.

WILLIAM J. GALBRAITH, civil engineer, Montreal, Canada, died in that city Dec. 21. He was 32 years of age, and was graduated from McGill University in 1909. A year afterward he became associated with the Geological Survey in the Rocky Mountains. Later he entered the firm of M. P. & J. T. Davis as assistant engineer on caisson work for the Quebec bridge. Recently he became associated with the Foundation Co. of New York City as a superintendent of construction of shipways on the North Pacific Coast. He was a member of the British Institute of Civil Engineers.

CAPT. GRANDVILLE REYNARD JONES, Sanitary Corps, U. S. A., previously associate professor of civil engineering, Johns Hopkins University, Baltimore, died of influenza at Camp Benning, Columbus, Ga., Dec. 22. Captain Jones was graduated from Ohio State University in 1904 and from the Massachusetts Institute of Technology in sanitary engineering in 1907. His principal professional work was with the filtration plant, Washington, D. C. At Johns Hopkins University he designed and built the Hydraulic Laboratory and the Laboratory of Sanitary Research. He developed several courses in sanitary engineering for the senior classes in civil engineering at Johns Hopkins. Early in November of last year Professor Jones was commissioned in the Sanitary Corps, with the rank of captain, and was ordered to Camp Greenleaf, Georgia, for a brief period of training, at the end of which he was sent to Camp Benning as camp sanitary engineer.

Last Year's Coal Production More Than in 1917 by 36,000,000 Tons

Although the year 1917 was in itself a record year in bituminous coal production, that of 1918 exceeded this by 36,000,000 tons, according to official figures of the United States Geological Survey. The total production for the year just closed was almost 600,000,000 tons. This record was made under the spur of war-time necessity, with fewer men generally in the coal mines of the country than during 1917. Patriotism, increased efficiency, and the desire of the employees to support to the utmost, the Government in its various undertakings, and a better railroad car supply and movement are believed to be chiefly responsible for this increase in production. It is believed that the country at present has a sufficient bituminous coal supply to meet its requirements.

Gage of Argentine Railroads

The gage of the Argentine railways, as given on p. 1204 of the Dec. 26 issue of *Engineering News-Record*, should have been 5½ ft. for the first, 4 ft. 8½ in. for the second, and 3 ft. 3⅜ in. for the third, instead of 6 ft. 5 in., 4 ft. 9½ in., and 3 ft. 4 in., respectively.

Labor Ample, But Materials Still High in Central West

A report from the Central West indicates that an ample labor supply has become available within the past few days. All big munition plants have ended their war work, and employers of labor report more applications than they can handle. A contracting company having large drainage projects on hand in all sections from Minnesota to Louisiana reports a plentiful supply. This company suspended all operations last September on account of labor shortage, but is now going ahead with everything and even starting new projects. Another contracting company which specialized in cantonment and war plants reports labor plentiful at 40c. an hour in all cities where it is operating, whereas 10 weeks ago it could not get labor at 65c. No further shortage is anticipated, the company says.

Regardless of the disappearance of labor difficulties, however, building construction is still delayed on account of the high cost of materials, as was shown in recent bids for steel work.

A bid of almost $120 a ton on structural steel to be used in a proposed building in Chicago indicates that the steel price is still high, especially since this same class of work was quoted two years ago at half that amount. It is reported that architects who have work on hand are recommending that owners hold off until a price of $80 is allowed, and a report is current that a reduction will be made about Mar. 1.

Crushed Stone in 1917 Half the Total Stone Quarried

Crushed stone represented 48% of the quantity and 35% of the value of all the stone quarried in the United States in 1917, according to a bulletin of the United States Geological Survey. The total sales of crushed stone in the United States in 1917 amounted to over 40,000,000 short tons, valued at about $29,000,000, and the average value per short ton at the crusher was 72c., 11c. more than in 1916. Of the crushed stone produced, 66% was limestone, 20% traprock, nearly 8% granite, nearly 4% sandstone and a little over 2% miscellaneous rock, classed as trap.

New Machinery Association to Be Formed

Manufacturers of material-handling machinery will form an association similar to other national associations of manufacturers. Representatives will meet at the Hotel McAlpin in New York City Jan. 15 to hear a report of the temporary committee appointed last fall to consider the matter.

It is expected that the association will afford means for the coöperation of all manufacturers of material-handling machinery with the United States Shipping Board, the Port and Harbor Commission, the Railroad Commission, and other boards interested in the handling of material; also to extend the acquaintance and coöperation of manufacturers. It will also afford means for the concentration in a general bureau of statistical information, to cover the present methods of mechanical handling as now practiced in this country and abroad, the dissemination among the members of information collected and developed by the association, as well as educational campaigns and the collection of information on foreign trade.

A luncheon is announced at which the Hon. William C. Redfield, secretary of commerce, and Edward F. Carry, chairman of the Port and Harbor Facilities Commission of the United States Shipping Board, will speak. The announcement requests all manufacturers of material-handling machinery who desire to join the proposed association to sign an application and send it to J. A. Shepard, temporary chairman, care of the Shepard Electric Crane & Hoist Co., 30 Church St., New York City.

Chlorine Price Cut in Half

A contract for liquid chlorine for water treatment has been awarded by the City of Chicago on a bid of 8c. per pound, while market prices until recently have been 14 to 16c. The contract, given to the Hooker Electro-Chemical Co., Cleveland, Ohio, is for 400,000 lb. for the 1919 supply, delivery to be made as required by the city.

Business Notes

Charles H. McCullough, Jr., was elected president of the Lackawanna Steel Co. at a recent meeting of the board of directors. Mr. McCullough has been vice-president and general manager of the company, and succeeds Edward A. S. Clarke, who resigned a week ago.

S. M. Williams, president of the Highway Industries Association, and for the past four years sales manager of the Garford Motor Truck Co., has been relieved of his duties as sales manager to take charge of the new department of highway development which has been established by the company.

Walter N. Polakov, consulting engineer, 31 Nassau St., New York, announces the founding of Walter N. Polakov & Co., Inc., consultants in power-production methods, industrial investigations, labor problems, scientific record systems and production accounting.

The Brown Hoisting Machinery Co., Cleveland, Ohio, announces the following changes in its organization: Harvey H. Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice-president, general manager and director.

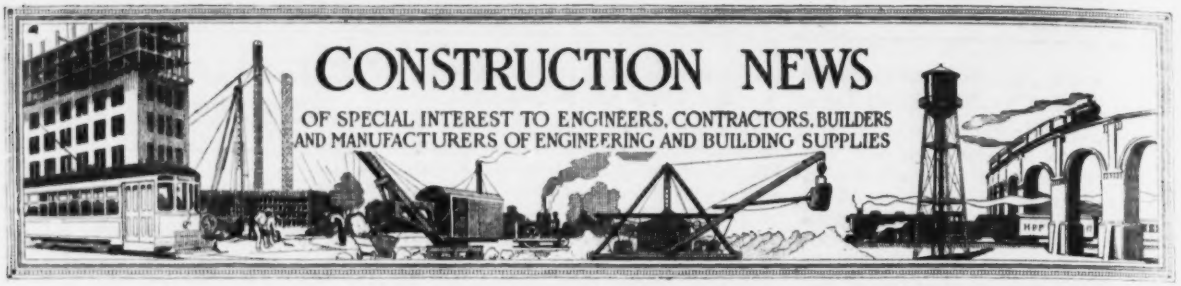
Trade Publications

The American Zinc Institute has issued its 1918 bulletin. It is a 5-p. folder outlining the aims of the institute and the reasons for its formation. Other information of interest to zinc users is given.

The American Manganese Steel Co., Chicago, Ill., has issued a new catalog on sand and gravel pumps, which they announce is for distribution among those interested in pump installations. It is a 6 x 9-in. pamphlet of 22 pages, punched for filing in a loose-leaf binder.

"Home Building with Metal Lath and Stucco for Permanence and Safety" is the title of a 7 x 9½-in., 20-p. catalogue issued by the Associated Metal Lath Manufacturers, Woodward Building, Washington, D. C. It illustrates and describes residences and buildings in which their product is used.

The Denver Rock Drill Manufacturing Co., Denver, Colo., has issued a leaflet describing its model 110 Waugh drill steel punching machine which, the company states, is one of its latest products.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages
54 and 55

WATER-WORKS

Bids Close		See Eng. News-Record
Jan. 10	Pembroke, Ont.	Jan. 9
Jan. 14	Detroit, Mich.	Jan. 9
Jan. 15	Kansas City, Mo.	Jan. 2
Jan. 31	Poteau, Okla. Adv. Dec. 19 and 26.	Dec. 26

SEWERS

Jan. 15	Long Island City, N. Y.	Jan. 9

BRIDGES

Jan. 13	Eureka, Cal.	Jan. 9
Jan. 13	Los Angeles, Cal.	Jan. 9
Jan. 22	Ft. Smith, Ark. Adv. Jan. 2 and 9.	Jan. 2
Jan. 27	Fallon, Nev.	Jan. 9
Jan. 27	Winnemucca, Nev.	Jan. 9
Feb. 3	Charlotte Harbor, Fla. Adv. Dec. 19, 26, Jan. 2 and 9.	Jan. 2

STREETS AND ROADS

Jan. 13	California	Jan. 9
Jan. 13	Brownwood, Tex.	Jan. 9
Jan. 14	Bay City, Tex.	Dec. 26
Jan. 15	Blytheville, Ark.	Dec. 5
Jan. 15	Indiana	Jan. 9
Jan. 16	New York, N. Y.	Jan. 9
Jan. 20	Oswego, Kan.	Jan. 2
Jan. 21	Charleston, S. C. Adv. Jan. 2 and 9.	Jan. 9
Jan. 24	Topeka, Kan.	Jan. 2
Jan. 27	Nevada	Jan. 9
Feb. 3	Wichita, Kan.	Jan. 9
Feb. 5	Indiana	Jan. 9

EXCAVATION AND DREDGING

Jan. 13	Delta, Utah	Jan. 9
Jan. 14	Albany, N. Y. Adv. Dec. 19, 26, and Jan. 2.	Dec. 26
Jan. 15	New Ulm, Minn.	Dec. 26
Jan. 15	Carnesville, Ga.	Jan. 9
Jan. 15	York, S. C.	Dec. 26
Jan. 21	El Centro, Cal.	Jan. 9
Jan. 27	Madison, S. D.	Jan. 9
Feb. 3	Madisonville, Ky. Adv. Dec. 5, 12 and 19.	Dec. 12

BUILDINGS

Jan. 14	Cherokee, Ia.	Dec. 19
Jan. 15	Norfolk, Va.	Jan. 9
Jan. 20	Hartford, Conn.	Jan. 9
Jan. 25	Asbury Park, N. J.	Jan. 9
Jan. 30	Phoenix, Ariz.	Jan. 2
Feb. 3	Melbourne, Fla.	Jan. 9
Feb. 3	St. Paul, Minn.	Oct. 31
Mar. 15	Culver, Ind.	Dec. 26

FEDERAL GOVERNMENT WORK

Jan. 10	Post Office—Vineland, N. J.	Dec. 5
Jan. 10	Altering Lobby—New York, N. Y.—Adv. Dec. 19 and 26.	Dec. 26
Jan. 13	Additional Buildings—Spec. 3611—San Diego, Cal.	Dec. 19
Jan. 13	Post Office—West Point, Ga.	Dec. 5
Jan. 13	Post Office and Custom House—Ft. Fairfield, Me.	Dec. 5
Jan. 13	Post Office and Court House —Globe, Ariz.	Dec. 5
Jan. 13	Altering Post Office and Custom House—Petersburg, Va.	Jan. 2
Jan. 14	Hygienic Laboratory — Washington, D. C.	Jan. 2
Jan. 14	Post Office — Southbridge, Mass.	Dec. 5
Jan. 14	Post Office—Cherokee, Ia.	Dec. 5
Jan. 14	Post Office—McKees Rocks, Pa.	Dec. 5
Jan. 14	Sewers—Wash. D. C.	Jan. 9
Jan. 15	Altering Post Office—Portsmouth, Va.	Dec. 26
Jan. 15	Post Office — Long Island City, N. Y.	Dec. 5
Jan. 15	Post Office—Kenton, O.	Dec. 5
Jan. 15	Post Office — Bellefourche, S. D.	Dec. 5
Jan. 15	Post Office — Winchester, Mass.	Dec. 5
Jan. 16	Post Office—Eldorado, Kan.	Dec. 5
Jan. 16	Post Office—Shawnee, Okla.	Dec. 5
Jan. 17	Post Office—Franklin, Pa.	Dec. 5
Jan. 17	Post Office—Cohoes, N. Y.	Dec. 5
Jan. 17	Post Office—Buffalo, Wyo.	Dec. 5
Jan. 18	Irrigation—Boise, Idaho	Jan. 9
Jan. 20	Gas Holder, Removing System, etc.—Spec. 3594—North Ft. Worth, Tex.	Jan. 9
Jan. 20	Heating System—Spec. 3722 —Rockaway, N. Y.	Jan. 9
Jan. 20	Oil Storage Buildings, etc.— Spec. 3714 — Hampton Roads, Va.	Jan. 9
Jan. 20	Post Office — Harrisonville, Mo.	Dec. 5
Jan. 20	Post Office—Owego, N. Y.	Dec. 5
Jan. 20	Post Office—Sunbury, Pa.	Dec. 5
Jan. 20	Post Office—Decatur, Ala.	Dec. 5
Jan. 20	Post Office — Shelbyville, Ind.	Dec. 26
Jan. 23	Post Office—Salem, Va.	Jan. 2
Jan. 23	Post Office — Russellville, Ark. Adv. Jan. 2.	Jan. 2
Jan. 28	Dredging—Key West, Fla. Adv. Jan. 2 and 9.	
Feb. 4	Boilers—Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 4	Turbine, Pumpset, etc. — Memphis, Tenn. Adv. Jan. 9.	Jan. 9

MISCELLANEOUS

Jan. 13	Dump Cars — Winnipeg, Man. Adv. Jan. 9	Jan. 9
Jan. 14	Heating, Plumbing, etc. — Sonyea, N. Y. Adv. Jan. 9	Jan. 9
Jan. 16	Portland Cement, Sand, etc. —New York, N. Y.	Jan. 9
Jan. 24	Sheet Steel Rivets—Los Angeles, Cal.	Jan. 2
Feb. 3	Dam—Los Angeles, Cal.	Jan. 9
Feb. 19	Gantry Crane — Seattle, Wash. Adv. Jan. 2 and 9.	Jan. 2

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mich., Ferndale (Royal Oak P. O.)—G. Jerome, engr., 1331 Majestic Bldg., Detroit, receives bids about Feb. 1, furnishing and laying water mains for complete water system for village. About $99,000. Noted Dec. 5.

Wis., Oshkosh—City will sell $50,000 bonds Jan. 17, to improve water-works. A. March, comptroller. Noted Dec. 26.

Minn., Fairmont—City receives bids in February or March building 1,000,000 gal. water purification plant. C. H. Currie, Webster City, Ia., engr.

Minn., Minneapolis—Golden Valley Golf Club plans to extend water system at Golden Valley, 5 mi. west of here. About $20,000. E. Von Ende, 651 Plymouth Bldg., secy.

Kan., Elderado—Black & Veatch, engrs., Interstate Bldg., Kansas City, Mo., making survey of water system and investigating feasibility of building ground water supply and dam for collecting and holding water up river.

N. D., Belfield—City receives bids in spring building water-works system, including rein.-con. pump house, c.i. pipe, mains, rein.-con. reservoir, etc. Former bids rejected. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Minn., engr. Noted Sept. 12.

Mont., Ft. Benton—City election Jan. 17, to vote on $35,000 bonds to improve water-works system.

Wash., Spokane—City plans to install steel and iron headgates, with operating devices at Upriver pumping plant to replace old timber headgates on masonry dam, cost $30,000; also replacing 6 mi. wooden water pipes with 6 in. steel mains. Will purchase equipment and install same by day labor. A. Lindsay, supt.

Que., Lachine—See "Industrial Works."

Sask., Assiniboia—City plans to complete water-works system. About $20,000. Address J. Nolan.

BIDS DESIRED

Mich., Detroit—Until Jan. 14, by H. S. Starkey, secy. water comn., 232 Jefferson Ave., furnishing 1000 tons 6 in. c.i. pipe and 1000 tons 8 in. c. i. pipe. G. H. Fenkell, 232 Jefferson Ave., engr.

Ont., Pembroke—Until Jan. 10, by town clk., furnishing 1600 lin.ft. 20 in. c. i. pipe, 15 flexible joints, two in. gate valves and 1 screen for water-works intake. W. J. Moore, town engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

Mich., Wyandotte—City received bids Dec. 30, (1) furnishing and laying 1450 ft. submerged intake pipe and elbows equipped with flanges and joints, removal of existing elbow, relocating existing crib, final testing, dredging and backfilling and all labor and material, involving 1450 ft. 24 in. c. i. pipe. Alternate bids on (a) Fenkell joints, (b) Ward joints, (c) Metropolitan joints, (d) Walker flexible joints; (e) according to bidder; (2) building filter plant with 6,000,000 gal. daily capacity, composed of six filter units, 21½ x 24 ft. of 1,000,000 gal. capacity each, 40 x 65 ft. and 37 x 73 ft. brick and steel filter and head houses, 2 coagulation basins, 64 x 94 ft. each, filtered water reservoir having capacity of 850,000 gal., usual equipment of hydraulic valves and controllers and 32 x 50 ft. brick addition to pumping station, (a) using concrete piles with alternate on reservoir; (b) using wood piles with alternate on reservoir, from Amer. Constr. Co., 1552 Rockefeller Bldg., Cleveland, O., (1a) $55,340; (1b) $52,155; (1c) $52,155; (1d) $53,155; J. H. Baer, Penobscot Bldg., Detroit, (1d) $51,750; (1e) $48,632. Class "B" pipe with Walker flexible joints at 72 ft. intervals; Lennane & McIlvenna, 809 Union Trust Bldg., Detroit, (1d) $45,000; Great Lakes Dredge & Dock Co., 1620 Williamson Bldg., Cleveland, O., (1a) $49,300; (1c) $60,900; (1e) $51,475, ordinary B & S pipe Class "B" with Thatcher joints; A. O.